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THE IMPROVEMENT OF HEVEA.

About the year 1905, when rubber seed was scarce, propagation of *Hevea* by cuttings was tried and proved a failure ; and the subsequent abundance of seed diverted attention from other possible methods of vegetative reproduction. As the millions of trees came into tapping it became evident that they differed considerably in yield; and Parkin, we believe, was the first to suggest the advisability of improving the race by controlled breeding. That was scouted as impossible, with trees the size of *Hevea*. At the present day we know that only about twenty per cent. of our trees are good yielders, so that, on that count alone, when seed is taken from an average field, it is four to one against the resulting trees being good yielders. When, in addition, it is understood that almost all *Hevea* seed is the result of a cross, it will be realised that the odds against securing good trees from ordinary estate seed are very much longer. But practically all estates have been planted from such seed.

Vegetative propagation of rubber was shown to be possible in Java in 1916. The subject was taken up seriously by a number of estates, and, both on estates and experiment stations, great advances have been made in Java and Sumatra. Not only has it been possible to develop budded trees for tapping, but, what is probably more important, by means of budded trees cross fertilisation between selected clones can be controlled and pedigreed seed obtained. We reproduce in this number some extracts from recent accounts of the work done in those countries.

In British rubber-growing countries, we believe without exception, the situation is totally different. During the last few years, the impression has been enforced that there is throughout an extraordinary eagerness to seize on every report adverse to budded rubber and consider it the final word on the subject. Difficulties are magnified and the slightest obstacle is considered insuperable. It is difficult to suggest an explanation of this attitude.

Quite naturally, in the haste to show results, accounts of experiments have been published which ought never to have attained the dignity of print. Many of these were estate experiments, subject to all the defects which inevitably accompany experiments under those conditions, and they have been

published with all their imperfections thick upon them. In some instances an examination of the data would have shown that the origin of the experimental material was very much in doubt, or that the conclusions were not warranted. But these conclusions have been accepted, one might almost say welcomed, as illustrating the failure of budded rubber.

A short time ago it was stated that, because of the uncertainty of budded rubber, estates in the Dutch East Indies were being advised to plant with alternate lines of bud grafts and seedlings. It will be seen from Dr. Heusser's paper that the actual recommendation bears a rather different interpretation. It is—at the present time, plant bud grafts, together with seedlings either from seed gardens (controlled fertilisation) or from good yielders; but if neither kind of seed is available, plant bud grafts only.

It is urged that at the present day there is no money for work of this kind. But the first steps cost very little. How many estates have taken the preliminary step of ascertaining their best yielders, and keeping them under observation to determine whether their good qualities are constant, or whether they may not depend on environment? This is essential, before any work can be done.

Another objection is that all this is useless because rubber estates are already planted up. It is forgotten that there will be replacements, and quite probably re-planting. If budded rubber, or rubber from pedigreed seed, fulfils its present promise, there will be no choice in the matter. The country which can produce twice the crop from half the number of trees will drive out the others. Every estate should have budded trees forming pedigreed seed gardens. In a matter of this sort, one cannot come with a rush at the finish. In spite of the British talent for improvisation, one cannot improvise mature rubber trees.

The era when success could be attained by pluck and sheer physical energy in starting a new product, if indeed it has not passed for ever, is destined to experience a long eclipse. It is possible that there may some day be another new product to which these qualities may be applied, but it is not yet in sight. Let it be remembered that rubber was "in sight" for forty years before it became an established plantation product, and it had a long history prior to that. Success in the future will depend upon the improvement of our present products, and that is what our competitors are doing. The British planter has been a pioneer, and he has reaped the rewards of a pioneer. He is sometimes apt to grouse that others take advantage of his pioneering and come in where he has left off. Naturally they take advantage of all available information. But he has small reason to complain if they improve on it. It is open to him to do the same.

RUBBER.

HEVEA SELECTION.

DR. C. HEUSSER.

The following extracts are taken from a lecture on *Hevea* selection, delivered by Dr. Heusser at a meeting of the A.V.R.O.S. at Medan on March 3rd, 1924, and published in the *Archief voor de Rubbercultuur*, VIII, No. 7 (July 1924).

In general selection methods may be divided into

I. Mass selection

II. Mother tree selection
   - A. Vegetative propagation (bud-grafts, marcotting, cuttings)
   - B. Propagation by seed (selection of uniform seed races, pure lines)
     1. Illegitimate seed
     2. Legitimate seed (seed gardens and artificial pollination)
        - a. Cross-pollination
        - b. Self-pollination

I. Mass selection is the method which consists of always obtaining seeds from good yielding plantations; thus, for *Hevea*, from plantations heavily thinned out on a selective basis. In cultivations where the fruit is the product, wholesale selection is generally unconsciously adopted. For instance, if a Malay harvests coconuts he throws them on a heap; if he takes coconuts from the heap for planting purposes he has a good chance of obtaining seed-nuts from high yielding coconut trees, as these are in the majority. The same happens with rice. The good plants produce more grains than the bad ones; therefore they are in the majority in the planting material. In the same way, coffee and many other plants which are cultivated for their fruits are unconsciously selected.

With *Hevea*, which is not cultivated for the sake of its fruit, unconscious selection will never occur. On the contrary, haphazard harvesting of seed will be retrograde selection. The fact that one half of the yield of our present day plantations is afforded by barely 20% of the trees shows that the majority of the trees produce below the average; therefore if the seeds are gathered at random we have a much greater chance of harvesting seed from poor yielders than from good yielders. In such a case we should be contra selecting. On the average, out of every five seeds we should find four seeds from poor yielders and one seed from a good yielder.

If mass selection is to be of benefit in *Hevea*, then at least 75% of the bad trees, or all the trees producing below the average, would have to be eliminated.

II. Mother tree selection is much more promising and is the correct selection method for permanent cultivations. The trees can be kept under observation for years; in the selection of the mother trees we can pick out

the hereditary good trees with some certainty by estimating the influence of environmental conditions, and with great certainty by tests of their bud-grafts; and by doing this, we can begin the selection work with the best of the best trees. Owing to the vastness of our plantations we have millions of trees at our disposal for selection. The hereditary good trees can then be vegetatively propagated, that is by marcottings or bud-grafts, or generatively, that is by seed.

The vegetative offspring of a tree is called a clone.

The hereditary composition of a mother tree does not change with vegetative multiplication. A hybrid segregation does not take place when making a cutting or bud-graft. Each cutting or bud-graft is an unchanged part of the mother tree. The hereditary tendency for rubber production is inherited unchanged, and can be influenced only by environmental conditions such as soil, climate, tapping system, tapper, and in the case of bud-grafts by the stock. This last, the influence of the stock, is the dark spot with vegetative *Hevea* selection. The bud-grafts on which we are at present dependent are artificial productions; we force two different living individuals, stock and bud-graft, to form a living relationship, and this may cause disturbances in nutrition. It is conceivable that the stock may take up substances, which either in quality or quantity are not suitable for the bud-graft, or that the bud-graft may form materials which cannot nourish the stock properly. The phenomenon that the bud-grafts of some mother trees "take" better than others is probably due to such factors. Mr. Schmole noticed that our pedigree tree No. 163 takes exceptionally badly; others, Nos. 49, 80, 36, can be bud-grafted very easily. It is possible that the disturbances may also be of an anatomical nature, if the vessels of the tissues of the two plants do not perfectly correspond.

[These suggested explanations are scarcely in harmony with present botanical knowledge.—Ed.]

If it were possible to multiply mother trees by cuttings or marcottings, and so escape the whole problem of stocks, then vegetative propagation would gain in certainty very much. Alas, we have not been able to give as much attention to this subject as it deserves. In 1920, we were able to marcot 93 per cent. of 1,600 one-year-old seedlings with success, of which 72 per cent. were made in the field. On marcotting bud-grafts of the same age the successes were practically nil, and even when they formed roots, these died after planting out. It was intended to bud-graft in nurseries and afterwards make marcottings on the one-year-old bud-grafts. A private institution on the East Coast which stands on a very high level in selection matters, has also had little success with the same problem. As there are many planters with horticultural training, who have had more practical experience than we botanists have, I call upon them here to give this problem their attention, and to work out a method which is applicable in estate practice.

In spite of the probable disadvantageous influence of the stock, we have obtained very gratifying results from the tapping of the bud-grafts. The average yield of the best offspring was more than double of that which is expected from seedlings of the same age.

Theoretically, selection by breeding is the best; economically however, it is perhaps not so yet. With a perennial cultivation, where the trees only

come into tapping after four to five years, we have to count on a period of five to six years from generation to generation. As a result of hybrid segregation, we shall get many bad types in the first generation. In the second generation, a greater percentage will already be better trees, and if we are so fortunate as to find a uniform and practically pure high-yielding race, then we may plant large seed gardens of these trees and success will be achieved. A seedling from a high-yielding race, as a plant, deserves preference over a bud-graft. If we have no luck, then we shall have to propagate for four or five generations or more to get so far.

Theoretically, the quickest way of attaining our object is to employ self-pollination, provided this does not cause degeneration phenomena and the trees are not sterile.

With cross-pollination, the process will be longer, but it will lead to a good progeny much quicker than if we are dependent on propagation by illegitimate pollination.

Tapping experiments with offspring of selected mother trees are only known from illegitimate seedlings. We secured legitimate offspring by artificial pollination in 1919 and 1920, however, and are eagerly looking forward to the time when they can be tapped, to test the above-mentioned advantages of legitimate seed.

When an estate has chosen a set of selection trees according to the lines laid down in our Leaflet No. 22, we then advise the following :—

Of each mother tree, a row of 100 to 200 bud-grafts is planted. For control purposes it is advisable to plant alternately bud-grafts from the estate and from A.V.R.O.S. trees which have already been tested After 4 or 5 years the bud-grafts are tapped experimentally. In the meantime observation of the estate's mother trees is continued. The latter should preferably be tapped daily on one-third the circumference by the same tapper to ascertain if they remain resistant to brown bast, yield constantly, and do not show any unfavourable characteristics. By means of this information, and by means of the experimental tapping of the bud-grafts, the final choice is made and the worst clones are eliminated.

A Company which owns other cultivations besides rubber, will do well to isolate this garden in the middle of other plantations such as tobacco, tea, oil-palms or coconut palms. (Gardens in the forest have not answered expectations; they are subject to considerable damage, control is difficult and they give much disappointment.) If, four or five years after planting the garden, success has been obtained in tracing and removing the bad clones, then we have not only a garden for budding wood, but also a good seed garden.

With an experimental field of 25 acres, 10,000 to 20,000 seeds and abundant budding-wood for extension, renovation or interplanting the old plantations may be counted on after five years.

Those who want to extend now, however, will be safest in planting a mixed bud-graft and seedling plantation ; using for bud-grafts preferably tested A.V.R.O.S. trees, or if they have their own tested clones at their disposal, budding from these. For seedlings, if possible, use seeds from seed gardens, or at least seeds from good yielders. If neither of these are available, then a pure bud-grafted plantation should be made. It is at

present unwise to plant with unselected planting material. Budding-wood from good trees is procurable in sufficient quantities; the experimental station has already distributed its good individuals over the whole district : they are present in Tamiang, Serdang, Siantar, Asahan, Kotta Pinang and Tapanieli. There will, however, be a shortage of selected seed for a few more years.

The selection plan of the experimental station is partly the same as that for the estates. We try to collect the very best trees in the district as budgrafts in our experimental gardens; we examine them later on and cross the very best ones amongst each other. The offspring are planted in our experimental gardens and are tapped later on; the best yielders are again chosen, examined and crossed, and so on from generation to generation. The experimental station thus takes upon itself, in the first place, the selection of pure breeding races, of pure lines; but in the meanwhile, however, it will not forget to release to the estates for vegetative multiplication for the purpose of seed gardens or plantations, the new varieties, which must improve with each new generation.

Directly after the establishment of our experimental station in 1917, selection work was taken in hand by Dr. Rutgers with the assistance of Mr. Corporaal. A number of seeds from seven good trees were received from the well-known planter Hamaker of Kiara Pajong, and were planted in the planting season 1917 in our experimental field in the A.V.R.O.S. lane. In August, 1923 the trees, then six years old, were tapped for the first time and are now tapped regularly. The 200 tapped trees gave :—

1 tree	½ per cent.	... ...	0— 1 gr.
25 trees	12½ ,,	... ...	1— 2 ,,
51 ,,	25½ ,,	... ...	2— 3 ,,
42 ,,	21 ,,	... ...	3— 4 ,,
37 ,,	18½ ,,	... ...	4— 5 ,,
12 ,,	6 ,,	... ...	5— 6 ,,
8	4 ,,	... ...	6— 7 ,,
9	4½ ,,	... ...	7— 8 ,,
4 ,,	2 ,,	... ...	8— 9 ,,
4 ,,	2 ,,	... ...	9—10 ,,
1 ,,	½ ,,	... ...	10—11 ,,
2 ,,	1 ,,	... ...	11—12 ,,
1 ,,	½ ,,	... ...	12—13 ,,
1 ,,	½ ,,	... ...	13—14 ,,
2 ,,	1 ,,	... ...	14—15 ,,

The best tree gave	14·69 grams
The average production was	4·02 ,,
Mother tree No. 7 gave the best offspring with an average of ...	5·41 ,,
Mother tree No. 6 gave the worst offspring with an average of	3·12 ,,

After the third experimental tapping, all the trees with the exception of 37, or 18 per cent., were thinned out. From these trees seed will be harvested next year.

4·02 grams may be considered good for the bad rubber soil, a stiff clay soil, in the A.V.R.O.S. lane, and surely means an improvement.

At the same time that this seed was obtained, the first register was opened, and the collecting of data about high-yielding trees was started. This work, the "Selection of Mother trees," has continued unchanged in principle up to the present time. It is true that we become more critical from year to year ; some of the old individuals have been eliminated and newly discovered ones have been well examined before they were entered in the register. Since we have come into possession of the experimental garden, Soengei Pantjoer, a set of bud-grafts has been made from all these elite trees, in order to get a collection of forms of the best trees on the East Coast. For breeders, this concentration of the propagation material is of great value ; we can accomplish the technically difficult artificial crossing in one place which is accessible in a short time. Furthermore, we can compare the trees with each other. When choosing the trees we have always attempted to collect the best trees from the tuff soils, the clay soils, and from the tertiary sandy clay soils ; consequently we have bud-grafts from trees from Tamiang, from Upper and Lower Langkat, from Serdang, Siantar, Batoe Bahra and from Kotta Pinang. The possibility of being able to choose in such an extensive manner is due to the fact that a great number of the estates are busy tracing their best producers ; the number of mother trees which are under observation on the East Coast amounts to thousands.

Thus it need hardly be said that the beginning of selection work rests on the information and co-operation of practice. Later, when we are selecting our daughter generations, we hope to return the material received in a refined condition.

We received the first important help from Tjinta Radja estate. Mr. Ihmof had already begun to measure the production of a set of seed trees regularly in 1916. In 1917 we received a small quantity of seed from seven of these trees, which I was able to plant in the A.V.R.O.S. lane garden in 1918 as one year old stumps. Of each of the seven mother trees ten trees were planted. Of these 66 were successful ; they were tapped at 4½ years of age, calculated from the time they were planted. Since September, these trees have been tapped each alternate month on half the circumference, beginning at a height of half a metre.

The average production from all the trees is 7·1 grams, which is very good and considerably better than from ordinary seedlings and also better than from the Kiara Pajong trees. The comparison of the groups of descendants with each other is interesting, and even more so is the comparison of the descendants from one mother tree.

Mother tree No. 36 is by far the best, mother trees Nos. 32 and 26 are only about half as good. The remaining three are about the same.

Concerning the variation of the yield in a descendant, tree No. 36 has yielded, besides the best yielders, also a fairly uniform offspring. Of the ten seedlings there are seven which are above the total average. The seedlings of mother tree No. 35 are medium or bad yielders, but one of them, No. 10, reaches 20½ grams, the highest yield of all the 66 experimental trees. Chance must have brought two sexual cells with very good characters together at the origination of this plant. Mother tree No. 33 gave good and medium yielders, and only one of the ten an inferior one.

It is not quite correct to judge the individual qualities of these seedlings by their yield only ; the size of the trees should also be taken into consideration to a certain extent. A small tree which yields as much as a large tree is theoretically more economical. To express this in figures, we can calculate the production per 10 cm. circumference at a height of 1 metre. We should not rely too closely on these figures, however, as by this means we should select with a bias towards slowly-growing trees (our trees were all planted on the same day and have grown up under the same conditions), and that is not desirable.

Before the stumps were planted out I examined them for the number of their latex vessel-rows. 26/1 showed a peculiar phenomenon : 4 layers of laticiferous vessels lay directly on one another without any tissue between. With buds from the upper part which was cut off from this seedling, I bud-grafted two one year old chance seedlings which stood near by. These two bud-grafts, which are as old as the mother tree and the neighbouring trees, were tapped at the same time, with the following result :

Seedling 26/1 ...	...	5·61 grams
Bud-graft 1 from 26/1	...	7·49 ,,
,, 2 ,, 26/1	...	6·26 ,,

The bud-grafts yield more than the mother tree. The result of this small experiment contradicts the report of an unfavourable influence from the stock. It is a pity that I did not make a bud-graft of each tree.

The best trees, 35/10, 36/10, 36/4, 32/2, were again crossed successfully last year, and the seedlings were planted out on Sei. Pantjoer : (From 35/10 it was possible to get two trees from self-pollinated fruit).

Some time ago we got our first good legitimate budding-wood from Tjinta Radja estate. After this, Marihat estate placed the whole plantation with yield measurements at our disposal to choose from, and we brought wood from the best trees for vegetative propagation to Kampong Baroe. With the bud-grafts obtained, ten isolated seed gardens were planted in 1919 and 1920 on the estates of the Deli Maatschappij, situated around Medan, and on the estates of the Medan Tabak Maatschappij. The gardens were laid out according to the usual plan, whereby 4 bud-grafts from mother tree B were planted together with 21 bud-grafts from mother tree A

0 0 0 0 0
0 * 0 * 0
0 0 0 0 0
0 * 0 * 0
0 0 0 0 0

From these gardens we have already been able to harvest more than 10,000 seeds last year. More than half were sold to the Deli Mij. As far as we know, the young plantations from this seed have been mapped out, and we have arranged with the Deli Mij. that we may choose the best offspring from here also and use them to continue selection.

On Soengei Pantjoer we have also planted two and a half acres with seedlings from these seed gardens.

Larger seed gardens were planted in 1919 in the Massihi and Perdagangan forest reserves. These consist of bud-grafts from a large number of mother trees, and during recent years have principally served as gardens for budding-wood.

To test the mother trees, the bud-grafts standing in the seed gardens were tapped experimentally last year. The majority were, as a matter of fact, too young and too thin to be tapped, but for the purposes of selection we were primarily concerned with obtaining relative figures, with a view to eliminating eventual bad parents from the seed gardens, and replacing them by bud-grafts from better ones or providing opportunity for self-pollination. The following is a summary of the tapping results of the first tapping experiments which were lately published.

Up to the present time bud-grafts from 30 different mother trees have been tapped. As was to be expected, not all of them proved to be good ; the productivity of the various clones was very different. We divided them into three groups, according to the results of the first tapping experiments.

I. Clones which are expected to yield more than double the yield obtained from unselected seedlings of the same age. These are A.V.R.O.S. mother trees Nos. 33, 36, 49, 50, 52, 80, 152.

II. Clones which are good, but from which for different reasons we await further data before we definitely pass them or not. To these the following numbers belong : 31, 35, 60, 65, 74, 93, 135, 139, 142, 144, 147, 151, 163, 174.

III. Clones which we have rejected and which have been eliminated. Of a few of these only, a small number of trees are being retained for scientific purposes. Those rejected were Nos. 8, 9, 23, 51, 71, 149, 150, 82.

In the tapping experiments it was remarked that, within one clone, a close relationship exists between the yield and the girth of the stem, a correlation which Vischer was able to ascertain with bud-grafts in Java. As the girth increases so does the production.

If this relation is shown graphically, the girths being plotted horizontally and the corresponding yields vertically, then the bud-grafts of one clone would lie on practically a straight line. The yield of a bud-graft or of a clone should be judged in relation to the circumference of the stem.

Clones which lie near the correlation line of the comparative clone No. 52 are just as good as this one ; clones which lie far below this line are worse. It must now be emphatically stated that the increase of the yield with increase of girth does not occur in all the clones to the same degree as it does in clone No. 52. For instance, with clone No. 50 the correlation line is much steeper than that of No. 52 ; the yield of No. 50 increases in greater proportion, so that this clone is one of the best clones at present. Probably this difference in the behaviour of the clones is connected with the bark anatomy, the "ripening" of the bark. This possibility, that a clone may become better later on, must also be taken into consideration in the case of the clones which were found bad at the first tapping experiments. If this backwardness lasts for years, then it is a bad characteristic of the clone and it does not deserve to be used for selection purposes.

The existence of a good correlation between yield and girth permits the presumption that the influence of the stock on the yield is fairly uniform, and with good clones it is not very marked. With medium or bad clones, the influence of the stock on the yield may be of more importance. At a

private institution which has at its disposal the oldest bud-grafts on the East Coast of Sumatra, it has also been stated that the correlation in bad clones is less than in good ones.

To confirm the results of the first tapping experiments and to ascertain the increase of yield, the clones of the first group and also part of the second group were tapped regularly every alternate month from the beginning of this year. I want to demonstrate to you some of the latest results. Clone 50, seven trees, 5 years old, gave an average of 16·83 grams per tree per day in January (16—30 Jan.).

Our very best developed bud-graft, No. 16 of clone No. 80, yielded for 20 days in February an average of 24·4 grams per day.

Clone No. 33 (10 bud-grafts) gave an average of 12·4 grams in January. If we compare the yield of bud-grafts from No. 33 with the December yield of the illegitimate seedlings from No. 33, the comparison is by far in favour of the bud-grafts, in spite of the fact that they are a year younger.

Seedlings (December) 6·8 grams
Bud-grafts (January) 12·4 ,,

Of clone No. 35 only two bud-grafts were tappable as the garden is not very favourably situated. The tapping results are also not very favourable. But the seedlings show by their great variation that mother tree No. 35 is, as a matter of fact, not hereditarily the best one.

Seedlings, average, January ... 7·1 grams
Bud-grafts, ,, December ... 7·6 ,,

Here also the bud-grafts are more than a year younger.

From clone No. 36 we have as yet no figures comparable with the seedlings. Two five-year old bud-grafts which were frequently pruned have yielded 6 and 8 grams. The remaining bud-grafts in the seed garden are now barely four years old; their yield is already such, however, that it is certain that the bud-grafts will be better than the seedlings.

After obtaining the first tapping results of the bud-grafts, our agricultural department greatly extended our pedigree gardens with bud grafts from tested clones, at the same time substituting good clones for bad ones. It is our intention to distribute budding-wood only from clones in group No. 1 in future. For planting estate pedigree gardens these clones have been used exclusively.

Besides this change in the pedigree gardens the greater certainty regarding the quality of our mother trees has justified us in planting two new isolated seed gardens of two and a half acres each in Deli Toewa in co-operation with the Deli Mij. We supply the planting material and the Deli Mij. will look after the upkeep, while we take charge of the technical supervision. The expected yield of seed and budding-wood will be equally divided. One garden will be exclusively planted with clone No. 36, because this one seems subject to self-pollination and has already given such remarkably good offspring with illegitimate pollination.

Artificial pollination between good trees was first adopted in 1919 on Tjinta Radja estate with success, but only on a small scale. The pollination method devised in 1918 seemed to be satisfactory. In 1920 pollination

was carried out on a large scale on Bandar Klippa, Tjinta Radja, and Tandjong Morawa estates. To reach the tops of the branches of the trees, which were more than 75 feet high, the above-named estates built large scaffoldings around the selected trees.

In 1919, mother tree No. 36 was pollinated with 35, and 49 with 36. A small garden which was planted from this seed on Tjinta Radja estate will be taken into tapping shortly.

In 1920, twenty mother trees were crossed in 35 different combinations. From the seeds which were obtained, more than 2,000, we were able to transplant safely 1,667 stumps in our experimental garden. Before transplanting these stumps, the well-developed small trees were marcotted in the nurseries, and the marcots were planted out on Bangoen estate.

At the end of 1925, we hope to be able to take the garden on Sei. Pantjoer into tapping, and the experiment station will then have at its disposal tapping results from seedlings from legitimate seed. This will be the first great experiment in which the effect of selection by breeding will be ascertained with legitimate seed. This experiment will show whether our present opinion, that in estate practice it is preferable for the time being to multiply the mother trees by vegetative means (bud-grafts, marcots) can be maintained. The development of the small trees is normal. In a few of the offspring the habit of the parents can already be recognised. For instance, the offspring from No. 49 × 26 show an inclination to form beautiful round crowns, a characteristic which both parents (especially the mother, No. 49) possess. Among the offspring from the crossing 164/161 there are six trees which show branch fasciations, the well-known band shaped branch deformations, which characteristic is peculiar to No. 164.

This summarises the present position of *Hevea* selection in our experiments tation.

You can see that we have been able, with the co-operation of the estates, to begin selection work with a liberal supply of material, and that we have approached the problem from different sides; perhaps you may have got the impression that we have started studying too many problems at the same time. I can well imagine that, at first sight, it would seem better to take each question separately and to solve it by simple experiments with large control plots. With annual crops this would be the correct method, but with a perennial cultivation like *Hevea*, with which, furthermore, selection work is still in an elementary stage, we must take other steps. To be able to accomplish something in a life time, it is necessary to start with a large number of trees, and the experiments for the solution of the problem must be heaped together. It is possible that unnecessary work may be done by this method, yet time is saved. To begin with, the experiments should not be too extensive; each large selection experiment takes so much space and is so costly, that one must make certain that the plantation can be worked later on. A failure in a tobacco field can be cleared away in three months; a selection garden of *Hevea* must, however, become a tapping field, and at worst it must not become inferior to an ordinary plot. We started in the first place, with the aim of working out the problem as quickly as possible by small many-sided experiments, and we have now come to a point where practical application can with advantage be made of the results obtained. We possess mother trees whose bud-grafts will give a much higher yield than the present estate trees. Further, we know that selected seed also will repay the costs and trouble expended by giving a higher yield; and we have signs which appear to indicate that we shall soon be successful in isolating a high-yielding race. The time has now come for making fundamental experiments on a large scale.

PRELIMINARY RESULTS WITH BUDDED RUBBER.

In the *Archief voor de Rubbercultuur* for July, 1924, Dr. P. J. S. Cramer has given the results obtained from budded rubber in the Cultuurtuin (Garden for Economic Products) at Buitenzorg during their first year of tapping, with other conclusions derived from a comparison of the budded trees with seedlings. As it is to strictly controlled work on Experiment Stations that we must look for valid information on this subject, the principal details have been included in the following account.

Dr. Cramer notes that the work has been carried out on a small number of trees, but he combats the suggestion that the results are thereby less reliable. As he points out, the small number of trees is counter-balanced by the fact that the material can be studied more intensively and thereby more information obtained from the data. "Just because our material consists of so few trees we can observe the peculiarities of each so much better." This view has been repeatedly urged in Ceylon. In a large scale experiment details which would afford explanations of the results obtained pass unobserved, or are obscured by an unwieldy mass of figures, and in consequence there are few large scale experiments in rubber which do not make large demands on our credulity.

Dr. Cramer discusses the possible mistakes which may be made in experiments on this problem, and gives an example of the occurrence of one source of error which has for some time cried for recognition. Three plots of buddings from three different mother trees were planted, 18 from mother tree No. 3, 18 from mother tree No. 88, and 12 from mother tree No. 9. The mother trees differed in the shape and markings of the seeds, and in other botanical characters. When the budded trees came into tapping, the yields of some differed widely from the majority of their group, and from a comparison of their seeds with those of the mother trees it was determined that the buddings had been mixed. The plot, for example, which was supposed to contain 18 budded trees from mother tree No. 88, included 5 from mother tree No. 9.

If mistakes of this sort can happen with small numbers of buddings on an experiment station, they are much more likely to occur in the case of large numbers of buddings in ordinary estate practice, and it is highly probable that such mistakes afford the explanation of many of the results which have been published. Not only so, but it is very questionable whether in such circumstances the identity of the mother tree is accurately known, five or six years after the buddings. There is also the possibility that in cases where the operator has to obtain five hundred or more buddings from one mother tree in a season, he may fill up with buds from other trees; or where the required number is secured in two seasons, the same mother tree may not be used each time. The published accounts of budding experiments strongly suggest that these errors have occurred in many cases, and it would require very close supervision to obviate them, when large numbers of buddings are being dealt with.

In one experiment which has provided the foundation of most of the current opinion on budding, large numbers of buddings were made from

among others, three selected mother trees. The buddings from mother tree A proved to be good yielders, like the parent tree. The buddings from tree B gave variable results. Part of them were good yielders like the parent tree, and the others poor yielders ; and this was explained on the supposition that, as in the instance quoted above, there had been a mixture of buddings from two trees, one tree B, a good yielder, and the other an unknown tree which was a bad yielder. In the third group, the alleged buddings from tree C, all the budded trees were poor yielders, unlike the parent tree, and hence it was concluded that the qualities of the parent tree are not necessarily transmitted to the budded trees. But obviously, if the conclusion regarding group B was correct, then the parallel conclusion regarding group C is that the buddings had not been obtained from the alleged mother tree, but from some unidentified poor yielder.

It is obvious to anyone who will carefully examine the published accounts that this uncertainty must exist in several of the recorded experiments. This is the more regrettable, as it prevents the acquisition of any valid data concerning possible bud variation in rubber.

Another source of error, pointed out by Dr. Cramer, lies in the fact that in budded rubber the scion may die back and a new shoot may arise from the stock. Only an inspection of the whole of the plants at frequent intervals during their early stages can detect that.

According to Cramer's results, buddings from one mother tree all show the same habit of growth, which, as far as has been observed, is identical with that of the mother tree. The growth of budded trees is slower than that of seedlings from the same tree, but this has been accurately determined only in the case of a mother tree which proved to be a slow grower. On the other hand, the growth of the budded trees is more uniform, and consequently, although fewer are tappable in the first possible year of tapping than in the case of seedlings the majority become tappable at the same time, so that the trees as a whole are tappable earlier than in the case of seedlings.

The stem of a *Hevea* tree grown from seed is conical, *i.e.*, the circumference near the ground is much greater than that at a height of three feet. In budded trees the stems are more cylindrical, though it is expected that they will become conical as the tree grows older. This again postpones the age at which a budded tree can be tapped.

The yield of budded trees from selected mother trees is greater than that of trees from seed, and the yields of the individual trees are more uniform. The yields, in the case of budded trees, varied from 33 per cent. below to 49 per cent. above the average, but in the case of trees from seed from one mother tree, they varied from 86 per cent. below to 196 per cent. above the average.

As with all rubber trees, the yield of budded trees varies with the season, but the variation is not much more pronounced than in the case of trees grown from seed. The yield increases as the tapping cut descends the stem, but it decreases when the lower end of the cut is about an inch above the point of union of stock and scion.

In the early buddings of rubber, the character of the stock was always neglected. Attention is now being given to this side of the question, and buddings are now being made on stocks of known parentage. By this means it will be possible to determine not only the influence of the stock on the scion, but also the influence of the scion on the stock. Dr. Cramer adduces evidence which indicates that when buddings are made from a fast growing tree the growth (increase in girth) of the stock is greater than that of seedlings from the same seed as the stocks. Thus it may be possible, by using buds from fast growing trees, to bring a field into bearing earlier with budded trees than with trees from seed.

The earlier buddings in the Cultuurtuin were made on seedlings in an ordinary nursery laid out with mixed seed, and consequently the stocks may be expected to be a mixture of good, medium, and poor yielders. Tapping on the stock, *i.e.*, on the lowest part of the budded trees, shows that there is a certain parallelism between the yield of the stock and that of the scion. In the case of the buddings from a single mother tree, when the stock proves to be a poor yielder, the yield of the scion is below the average of the group. On the other hand, unselected seedlings yield more as stocks budded from good yielders than they would have yielded at the same height if they had not been budded.

THE IMPROVEMENT OF OLD AREAS ON RUBBER ESTATES.

An Eastern correspondent writes to the *India Rubber Journal*, rather despondently regarding the results of the efforts that are being made to improve poor areas on old rubber estates, planted either at the time of the boom or shortly after when methods were largely influenced by the boom-time demand for rapid development. He refers particularly to old, over-tapped, late thinned-out areas and also to those areas where the soil conditions are uncongenial to the trees, and states his conviction that the money spent on efforts at improvement is in many cases lost. Any slight benefits which may accrue will, he thinks, never compensate for the money laid out. A great deal of the responsibility of the expense rests, he states, on the visiting agents, many of whom are very prone to suggest to boards in optimistic terms various methods for the improvement of old or poorly-grown areas where there are but very remote chances of the benefits from these endeavours being noticeable, not to say comparable with the expenditure thereby necessitated. If rubber was at a higher price and likely to be maintained there for some years so that the poorer yielding areas could be tapped at a fair profit, then it would be financially sound to risk a few dollars per acre in the hope of improving the yields of these poorer areas. At the present time, however, it seems to the correspondent that estates, cannot afford to take such risks and that any money which can be spared may be much better used to improve the good areas. These views come from a very high source, and deserve to be taken into careful consideration by the directorates of companies having blocks of poor rubber.—The Planters' Cronicle, Vol, XIX, No. 30.

CACAO.

CACAO MANURIAL EXPERIMENTS.

During a recent discussion on the manuring of cacao, the statement was made that, on the Experiment Station, Peradeniya, the best results from the use of artificial manures were obtained with nitrate of sodium when 800 lbs. per acre was applied, followed by 10 tons of cattle manure. The statement seemed so much at variance with the experiments on cacao manuring at Peradeniya, both as regards yield and method, that the source of information was sought, and that was kindly furnished by a reference to van Hall's book on Cacao.

In van Hall's *Cacao*, p. 400, there occurs the following passage.—

> "Systematic experiments have only been carried on at Peradeniya in the Botanical Gardens (*sic*). From these experiments it may be concluded that good results were obtained from nitrogenous manures ; it is a fact worth mentioning that the best results were obtained by green manuring with Crotalaria and an application of lime to the amount of two tons per acre; the second best results were obtained with nitrate of sodium (800 lbs per acre), followed by cattle manure (10 tons per acre). For further particulars reference may be made to the figures given in the Annual Reports of the Royal Botanic Gardens, Peradeniya."

This, of course, refers to three separate plots. Plot 3 received 2 tons of lime in 1903, and *Crotalaria* was sown and mulched in 1905 ; no further manures were applied, except the dadap loppings. Plot 95a received sodium nitrate at the rate of 800 lbs. per acre annually, in three applications, from 1903, the quantity being reduced to 400 lbs. from 1910. Plot 4 received 10 tons of cattle manure per acre annually from 1904. Thus the plots are readily identified. But the alleged results are widely different from anything recognised at Peradeniya.

The results of these cacao manurial experiments were published in *Circulars of the Royal Botanic Gardens*, Vol. VI, No. 4, October 1911, and they caused considerable discussion at the time. Some of the experiments were begun in 1903 and others were added in 1904. The account of the experiments deals with the results from 1905 to 1911. But these do not support van Hall's statement. His book was published in 1914, and does not include these 1911 results. Consequently, to find his figures we have to hunt back through the Annual Reports.

We find the source of his information in the Annual Report for 1906. That report contains a table, which gives the number of "ripe fruits per 300 trees" from 1903 to 1906. Even then it does not quite support van Hall's statement. The lime *Crotalaria* plot shows the greatest number of pods: the second best number is shown by the sodium nitrate plot ; the third best by the Ammonium sulphate plot ; and the fourth best by the cattle manure plot.

But apart from the fact that this is only an intermediate set of results, the table in question is quite unreliable. That was pointed out when it was published in 1907, and the Report for 1907 indicates the opinion of the Experiment Station Committee regarding it. It was the subject of prolonged discussion by the Committee in that year, and as a result of that discussion other methods of tabulation were adopted.

In the first place, the table gives the crop returns from 1903, though some of the plots were not manured until the following year. In the second it deals with calendar years, not with crop years. More important still, however, is the fact that it tabulates, not the actual crop, but the "number of ripe fruits calculated to 300 trees per acre."

There is always a doubt how far calculations to a standard number of trees per acre are admissible. The crop is, in part, a consequence of the number of trees per acre. If an acre bears 200 trees, its crop is made to appear fifty per cent. greater by calculating it to 300 trees per acre. If on the other hand, an acre bears 400 trees, its crop is made to appear twenty-five per cent. less by the same calculation. But the crop per tree may be less in the second case owing to overcrowding. The method assumes that the yield per tree is independent of the spacing.

In the present instance the results of the application of this method are almost ludicrous. When the Experiment Station was purchased, it was a jungle of huge shade trees, and these had to be felled, with the result that vacant spaces were caused which were afterwards planted with cacao. A careful census was kept of all the trees in each plot, and the cacao supplies were counted when they were 3 feet high. Naturally they were not then in bearing. But they were reckoned with the bearing trees, and consequently the calculated yield per 300 trees was reduced, the unfortunate plot which had most supplies suffering most. For example, the sodium nitrate plot, 95a, had 207 trees in 1905 and 250 in 1906 ; the 42 extra trees were supplies, and these would reduce the *calculated* yield by 17 per cent. But the parallel plot, 95b, manured with ground nut cake, had 276 trees in 1905 and 398 in 1906 ; the extra 122 trees were supplies, and these would reduce the calculated yield by 31 per cent. It was shown in 1907, by means of graphs, that the variations in the *calculated* yields depended principally upon the number of supplies. Consequently the table of 1906 is quite misleading.

The table in question does not agree with later tables, because the calculations were made on the "number of ripe pods," *i.e.*, not the number of good pods, but the number of good plus fungus plus squirrel pods. Subsequent statements omit the fungus and squirrel pods.

As already stated, the results of the experiments from 1905 to 1911 were discussed in Circular 4, Vol. VI. Several alternative methods of estimating the relative value of the different manurial treatments were suggested, but none of these methods yields conclusions which agree with those cited by van Hall.

Omitting the unmanured plots, table 5 of the Circular shows that if the plots are arranged in order of the average crop, plot 3, which received lime once is seventh, plot 95a, which received 800 lbs. sodium nitrate per acre annually, is tenth, and plot 4, which received 10 tons of cattle manure annually, is fourteenth.

If the yields are calculated to 300 trees per acre (table 6), omitting the unmanured plots as before, plot 3 is seventh, plot 95a is fifth, and plot 4 is nineteenth.

Another calculation, table 7, gives the average yield from 1906 to 1911, expressed as a percentage of the crop of 1905, which was a very large one. This mode of calculation was considered to be most likely to show the effect of the continued application of the same manure. In this table, again omitting the unmanured plots, plot 3 is fourteenth, plot 4, cattle manure, is eighteenth, and plot 95a, sodium nitrate, is twenty-second, *i.e.* last. The average crop of the sodium nitrate plots for 1906—1911 was only 46 per cent. of its crop for 1905.

The conclusion drawn from these experiments was that the best results were obtained from fertilisers containing phosphoric acid, especially when that constituent was combined with nitrogen in such a form as bone dust or fish manure.

In connection with the experiments, another point may be noted. When the results were published they aroused considerable adverse comment because details were included relating to two unmanured plots, Nos. 1 and 2, which gave larger yields than the manured plots. These two plots were treated as control plots, and hence it was assumed that the manuring had not produced any beneficial effects.

With regard to these two plots, Lock wrote in 1911. "We have no exact record of the treatment of plots 1 and 2 prior to 1903. They are however, situated adjacent to the cattle sheds, and it is understood that the plots received large quantities of dung in the form of a mulch." That, of course, was a conjecture. The two plots were certainly much better than the remainder of the estate, and as they were nearest to the bungalow, it is conceivable that they were the former proprietor's special show plots. But that was noted in 1903, and in the Report of that year it is definitely stated that plot No. 1 had been excluded from the manuring experiments because it was evidently superior to all the others.

On examining the earlier records, it is found that no mention is made of either plot 1 or plot 2 in the manurial experiments. The control plot was the old No. 33, which is the present No. 93. That plot lies on the opposite side of the paddy field to the manured plots, and consequently, in 1907, after an exhaustive consideration of the experiments by the Committee, plot 10, which is situated with the manured plots, was substituted as the control.

A further summary of these experiments was published in 1913 as Bulletin No. 5, but for some reason it omits the year 1905, and includes 1912, when no manure was applied, in a general jumble with the rest. Its authors were unable to bear the idea that an unmanured plot should yield more than a manured plot, and consequently they discarded plots 1, 2, and with them, the control plot No. 10, and proceeded to mould the results nearer to their hearts' desire. When the Experiment Station was begun, part of the old cacao was left uncultivated, to be replaced by other crops. The "control plot" selected for comparison in 1913 was part of this abandoned cacao, and it is situated at the opposite end of the station as far as possible from the manured cacao area. Tropical Agriculture is not lacking in comic relief.

COTTON.

MYSORE COTTONS AND THEIR IMPROVEMENT.

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Amongst the non-food crops of Mysore, cotton occupies the foremost position. It will be seen from the following statistics that the area under cotton is gradually on the increase and in the last ten years it has actually trebled. Dr. Coleman in his written statement to the Indian Cotton Committee says as follows :—

"I anticipate an increase in the average area under cotton for the decennium 1915—1925 of at least fifty per cent. of the average area for 1905—1915."

Decennium	Average area under cotton
1885-1895	49,614 acres
1895-1905	54,918 acres
1905-1915	94,790 acres

This increase is due, no doubt, to the rise in prices but incidentally it proves that Mysore is a very favourable area for cotton development.

Some years ago a farm was established near Hiriyur in the heart of the cotton growing area of the Mysore State. Scientific breeding work on indigenous cottons was then started and some progress in improving these cottons has been made. It is proposed to discuss in this paper the work that is being done towards improving these cottons.

The improvement of any crop may be brought about by one of the two following methods :—(1) Introduction of superior variety from outside. (2) Improving the local existing varieties by means of selection or hybridization or by both.

The introduction of varieties from outside, especially with a reference to cotton has, on the whole, been a failure. Prof. Gammie, the late Imperial Cotton Specialist, has very well traced in his paper on "Work done towards the Improvement of Cotton in Bombay Presidency,"* the various attempts made to establish American and Egyptian cottons which ended in almost a complete failure. He concludes as follows :—"Throughout the whole of the history of the attempts made to improve the cottons of India it is sufficiently evident that no consideration was ever given to the chance of improving any indigenous variety by scientific methods, the sole aim seemed to be to compete with the American market by introducing the cultivation of its chief cotton varieties into India."

* *Vide* Agricultural Journal of India, Vol. III. Part I.

Although the area under cotton in Mysore is comparatively small (115,000 acres, ·5% of the total area in India), still we find three distinct varieties growing under one popular name, "Sannahatti." In the northern part of the State bordering on the Dharwar district of the Bombay Presidency we have a cotton the seeds of which have a white fuzz growing on them. This fits into the description of *Gossypium herbaceum* Linn., and *G. obtusifolium* Roxb. var. *Wightiana* Watts. This occupies one-half of the Sannahatti area in the State. It gives a fairly high yield (between 8-10 maunds of 22 lb. per acre) with a ginning outturn ranging between 20 to 25%. The cotton is fairly strong with a length of $\frac{3}{4}$ in. to $\frac{7}{8}$ in. On the other hand, in the taluks of Molakalmuru, Pavagada and certain portions of Jagalur we find a cotton with naked seeds growing either as a pure crop or as a mixture with a fuzzy seeded variety. This corresponds to Prof. Gammie's *Gossypium herbaceum* var. *melanosperna* and to Watt's "Tellapatti." This is a heavy yielder and the lint has a good white colour, staple long and level and has also a fair strength. This gives a low ginning out-turn.

Lastly, we have a small area under cotton in the Mysore district. The variety that is generally grown there is the so-called "Nadam" a perennial variety introduced from the Coimbatore district. We find this occupying the best cotton soil in the district although this variety outside Mysore is generally grown on red soils. This has a low yield and ginning out-turn though a long and strong fibre. This answers to *Gossypium obtusifolium* Roxb. The one point in the above plant which seems to have been overlooked by other workers on cotton is the red colour in the filaments on the lower half of the non-delphous stamens which can be distinctly seen in a fresh flower. Recently, we have been able to isolate a clean seeded variety from amongst the "Nadam" plants. We have not been able to find any reference in the cotton literature to this type, though Mr. Hilson casually mentions it in his written statement to the Indian Cotton Committee.*

Although the varieties described above are grown in three distinct tracts, still in a field of Sannahatti we find a mixture in various proportions of all these varieties. For instance in a field of Jowari Sannahatti it is not uncommon to find Nadam and Tellapatti plants.

So the very first thing we did was to grow in pure cultures plants of all these varieties. When sufficient pure seed from all the varieties was obtained it was sown in plots of one-twentieth acre, each variety being repeated three times to get definite figures regarding their yield and ginning out-turn.

The following statement gives the yield and ginning out-turn of the three varieties of cotton :—

Name of variety.	Average yield per acre. lb. oz.	Average ginning out-turn
Chitaldrug Sannahatti (Fuzzy seeded)	231 4	28%
Nadam	186 4	21%
Chitaldrug Sannhatti (Clean seeded)	230 10	24%

Of the three varieties we find that the fuzzy seeded Sannahatti has very many advantages over the other two both from the ryots' as well as the spinners' point of view. Further the fact that it occupies half the cotton area warrants our devoting main attention towards its improvements.

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* Minutes of evidence taken before the Indian Cotton Committee, Vol. II, Agricultural, Part 2, p. 133.

In this variety we have been able to isolate two types of plants based on the branching habit. As is well known the cotton plant possesses two kinds of branches, one generally called a vegetative branch which does not produce flowers but produces other secondary branches which bear flowers and fruits. These branches are long and spreading and hence require more space to develop. The other kind is short and bears one to three flowers. Such a branch is called a fruiting branch. The main stem of a cotton plant may be divided into two distinct zones, the lower portion of the stem produces mostly negative branches and this is called the vegetative zone, while the upper portion has fruiting branches and hence known as the fruiting zone.

The first type consists of plants which have very few vegetative branches but mostly fruiting branches. In other words we have a plant possessing a single main stalk bearing a large number of fruits. In the second type, on the other hand, the main stem supports a number of vegetative branches while the fruiting zone is to a great extent reduced. It has been ascertained that this branching habit is heritable in the two types. When seeds of these two types were sown separately in a pure condition and harvested the following figures were obtained :—

Type.	Area.	1st repetition.	2nd repetition.	3rd repetition.	Total.
1st type "C" Type ...	1/20 ac.	8- 4	7-1	7- 6 ...	22-11
2nd type "E" Type ...	1/20 ac.	5-12½	6-8	6-12½ ...	19- 1

From the above it will be seen that the first type gives a higher yield than the second type. This is in accordance with the observation of other workers.*

A number of plants of this type was separately sown and plants harvested. It was found out that there was a wide range of variation in ginning outturn. We had plants which gave as low as 18 per cent. and plants that gave as high as 28 per cent. Plants of the latter type were selected and two strains from these are being tried on a large scale with a view to see if we can profitably introduce this type of cotton.

This first type being a compact plant admits of closer planting while the second type being bushy requires more space for its development. In order to ascertain the amount of space required to get the higher yield the following experiments were tried :—

First experiment giving half-a-foot spacing for both the types.

Second experiment giving one foot spacing for both the types.

Third experiment giving half-a-foot spacing for 1st type and one foot spacing for the 2nd type.

The following results were obtained :—

	1st Type.		2nd Type.	
	lb.	oz.	lb.	oz.
First experiment ...	132	4	125	0
Second experiment ...	103	12	135	12
Third experiment ...	150	0	128	0

* Report of the Imperial Cotton Specialist for the year 1916—17 O. F. Cook. Single stalk cotton culture, U.S. Dept. of Agriculture, Bureau of Plant Industry.

Thomas H. Kearney, Breeding new types of Egyptian Cotton, Bulletin 200,

From this it will be seen that sowing the first type giving half-a-foot spacing gives the best result.

In the Report of the Imperial Cotton Specialist for the year 1916-17 we find the following remarks regarding this cotton (p. 3) :—"Its chief defects are a rather low ginning percentage and the rosy colour of its cotton in bulk which detracts from its value in the eyes of the Bombay trade which prefers a quite white cotton."

It has been ascertained that the rosy colour is due to a variety of cotton having a drab colour grown in the mixture. When this cotton is eliminated the colour of Chitaldrug Sannahatti has materially improved.

The following is the mill report on the local Sannahatti and of the two strains :—

(1) *Local Sannahatti.*—The staple of this sample is irregular both in length and strength. There is a great amount of short fibres in the sample and it is also discoloured.

Sannahatti Sel. 45.—The colour of this sample is good being very white. The staple is level and the strength moderate.

Sannahatti Sel. 69.—This sample has a good white colour. The staple is level and the strength good.

The selection work on Mysore Nadam consists in isolating a type which gives a high ginning out-turn and a better quality of lint. We have been able to secure about a dozen plants which have given a ginning out-turn of 27 per cent. and whose quality of lint is equal to the Bani of Central Provinces. We have not as yet, owing to unfavourable weather conditions, been able to find out the yield of these plants.

Now we come to the last variety amongst Sannahattis. This is the variety which possesses black seed. In the classification of cotton by Watt, this variety does not find a place, as he has not made a group for cotton with black seeds with united bracts. Besides he traces the origin of this cotton as a result of hybridization between Bourbon (a plant belonging to the New World group) and Uppam (a plant belonging to the Old World group). This statement requires further support. The writer tried to effect crosses between American cottons and Roseum in which he did not succeed. Mr. Hilson, some time back, tried to effect a cross between Cambodia cotton and Roseum but failed. Therefore it seems that it is not possible to effect a cross between Bourbon and Uppam. The origin of this naked cotton must be a sport. As already stated we have isolated another clean seeded variety from amongst the Nadam cotton. Not much work has been done on these black seeded varieties although one interesting point that has been observed is that one of them is a heavy yielder.

Mr. Leake (now Dr. Leake) was also under the impression that there was no naked seeded variety amongst the Indian cottons. For he says, "At present no Indian cottons are naked seeded." He continues, "the cotton seed industry in India is in its infancy but will develop and Indian cotton seed is handicapped by the presence of the fuzzy adherent to the seed. This fuzz not only lessens the value of the cake derived but it diminishes the value of the seed as a direct fodder. The advantages of a naked seed are clear."

We have been trying to isolate a bushy type from this variety which gives a high ginning out-turn.

Hybridization work in Mysore cottons has been started and some progress in this work has been made.—The Journal of the Mysore Agricultural and Experimental Union, Vol. VI, No. 1.

FRUITS.

THE CHERRY AT NUWARA ELIYA.

T. PETCH.

Among the interesting botanical features of Nuwara Eliya are the comparatively large cherry trees which are scattered through the town. Several stand in a conspicuous position in the grounds of the Grand Hotel, and three of these, measured in October 1923, girthed 13 feet, 14 ft. 6 inches, and 16 feet, respectively, at a height of three feet from the ground.

The age of these trees is not known. Cherry trees were observed at Nuwara Eliya by Champion in 1843, and Gardner referred to them in 1849. As Nuwara Eliya began to be opened up as a Sanatorium in 1828, the date of introduction of this cherry lies between 1828 and 1843.

The Nuwara Eliya cherry is also of interest, in that it has furnished a standard example of the behaviour of European trees in the tropics. Champion, in 1843, stated that the cherry trees at Nuwara Eliya did not produce fruit, and Gardner, in an account of the vegetation of Ceylon, published in *Jour. Hort. Soc., London*, IV (1849) pp. 31-40, wrote "In place of losing their leaves for nearly six months of the year, the peach and the cherry are here evergreens, and hence are kept in such a continued state of excitement as to prevent their bearing. The peach does indeed give a poor crop of fruit of very inferior quality, but although the cherry blossoms annually, its fruit never comes to perfection."

These statements have found their way into classical botanical literature. De Candolle, in *Geographie Botanique* (1855), p. 391, recorded that when transferred to Ceylon the cherry does not lose its leaves. Pfeffer, *Pflanzenphysiologie*, II. p. 270, referred to the cherry in Ceylon as an evergreen, citing De Candolle. Askenasy, *Ueber die jahrliche Periode der Knospen*, Bot. Zeitung, 1877, p. 841, stated that the cherry was evergreen in Ceylon, and did not produce fruit.

In 1898, the foregoing statements were brought to the notice of Mr. W. Nock, who had held the post of Curator of the Hakgala Botanic Gardens, six miles from Nuwara Eliya, since 1882. Mr. Nock wrote as follows in the *Tropical Agriculturist*, XVIII. p. 187.

"The cherry has not become an evergreen; it loses its leaves at the end of every year, and for a short time is bare. It flowers abundantly in the locality of Nuwara Eliya (6,200 ft. elev.; 57·7° av. temp.). It sets but little fruit, and that generally falls off before the stoning stage. Occasionally I have seen fruit colouring, but have never seen one ripe. It is never reproduced by seeds, but plentifully by cuttings and suckers."

Thus, the statement that the European cherry has become an evergreen in Ceylon was based on incomplete observations. It is also incorrect from another standpoint. In 1921, Mr. E. H. Wilson, of the Arnold Arboretum, so well known for his botanical investigations in China and the

author of *The Cherries of Japan*, visited Ceylon, and the writer had the pleasure of accompanying him to Nuwara Eliya and Hakgala. On being shown the old cherry trees at Nuwara Eliya, Mr. Wilson immediately queried their identity, and, on flowering specimens being sent to the Arnold Arboretum later, he identified them as *Prunus Puddum* Roxb. Consequently the Nuwara Eliya cherry is not the cherry of European orchards.

Prunus Puddum is native to Nepaul and the Himalayan region. It was discovered by Major-General Hardwicke between Hurdwar and Srinagar, and was introduced into the Botanic Gardens, Calcutta. Voigt, in 1841, recorded it in his *Hortus Suburbanus Calcuttensis* as growing in the Botanic Garden at Serampore, but stated that it had not flowered up to that date. Hardwicke recorded that "The wood is much esteemed among the travelling Fakeers for bludgeons and walking sticks, and known in common by the name of Puddum." Puddum is Hindustani. The tree is known as the wild cherry of the Himalaya.

According to Wallich, the tree yields an edible fruit at Dehra, but not, or sparingly, in Nepaul. The Dictionary of the Economic Products of India states that the tree "produces an abundance of small oblong fruit, with a scanty yellow, orange, or reddish pulp, in spring. It is little, if at all, eaten by the natives, but is largely collected and sold to Europeans for making the well-known hill cherry brandy."

The heartwood is reddish and beautifully mottled ; it has a weight of 44 lb. per cubic foot. It is used for making walking sticks and pipe stems, and occasionally for building and furniture. Gamble remarks, "It deserves to be better known and to be more extensively used, as, at any rate in Sikkim, it is common and reaches a large size."

At the beginning of the last century, many plants were introduced into Ceylon from the Calcutta Botanic Gardens, either by the Royal Botanic Gardens, Peradeniya, or by military officers. It is probable that this cherry was introduced from that source, and by one of the military officers, as Nuwara Eliya was then a Sanatorium for the troops.

As regards the interest taken in horticulture by military officers, Cordiner records that "By the friendly care and persevering attention of Dr. Roxburgh, Superintendent of the company's botanical garden at Calcutta, General Macdowall was enabled to make a valuable collection of exotics, which he left in his garden at Colombo in February, 1804, when he was removed from the command of the forces in Ceylon to that of the northern division of the army under the presidency of Fort St. George. During his residence in Colombo he was in the habit of receiving boxes of trees and shrubs by almost every ship; and one acre and a half of ground was completely filled with them, ranged at proper distances, among which were observed the following."

Cordiner's list mentions peaches, the fruits of which fell when about the size of a pea, and apple trees which throve remarkably well but had not borne fruit. It does not include the Cherry.

FEEDING STUFFS.

SYSTEMATIC FEEDING OF COWS IN WILTSHIRE.

E. H. BRUCE DAVIS AND G. ERNEST HUGHES.

The following article is based on the writers' joint experiences of the feeding of dairy cows according to the system advocated by the County Agricultural Organiser for Wilts.

They were the first two farmers in the country to put into practice the advice given by the organiser in respect of feeding, and the purpose of the article is to give first hand their experience of the results.

The writers got into touch with the Agricultural Organiser owing to attending a course of lectures commenced at Warminster in November, 1922, and they were so impressed by the lecturer's remarks that he was asked to supervise personally the feeding and management of their milch cows.

Basis of the System.—The Organiser laid it down in his lectures that—

(1) Cows should not go up in milk on going out to grass.

(2) Heavy milking cows should not lose flesh.

(3) Cake and meal ought not to exceed 3½*d*. per gallon at the then current prices.

(4) A maintenance ration equivalent to 20 lb. hay should be given (*i.e.* 0·8 lb. digestible protein and 6 lb. starch equivalent).

(5) A production ration should be fed for each gallon of milk the cow is giving (standard 0·56 lb. digestible protein and 2·25 lb. starch equivalent).

(6) The total dry matter to be 27—33 lb.

(7) The cow should be prepared for her lactation period before calving (equivalent to 2 gallon ration).

(8) Strict attention should be paid to milking and daily recording as far as practicable.

(9) Concentrated food should be used in the maintenance ration for reduction of bulk in the case of heavy milkers.

(10) Roots should be dispensed with where they have to be bought. In any case not more than 50 lb. per day should be fed, and 30 lb. for preference.

(11) Chaff should be replaced by long straw.

The writers' farms differ in character, Farm A being a mixed farm on the greensand, one-third arable and two-thirds grass, and Farm B a totally grass farm on clay, adjoining the chalk. In both cases the grass is of good average quality.

Before commencing on this system, both herds had been recorded and attempts had been made to feed in accordance with yield. Both herds are non-pedigree Shorthorns, with a few Friesian-Shorthorn Cross heifers on Farm B

As the cows had previously gone up considerably on going out to grass, and the heavy milking cows had always lost flesh, it was felt that the system hitherto followed had not been correct. As far as cake and meal were concerned, the cost had, in the past, been somewhere in the neighbourhood of 5*d*. per gallon so that if the cost could be reduced to 3½*d*. there would be an immediate saving of 1½*d*. per gallon, even if no increased yield was obtained. In consideration of the above, the writers decided to give the system a trial.

Rationing System.—The system of feeding then adopted on the two farms was:—

Farm A. Hay 16 lb.
Straw (long) 4 lb.
Roots 30 lb.

Farm B. Hay 20 lb.

and, in each case, a production ration per gallon. In the case of heavy milking cows, the bulk of the maintenance ration was cut down by replacing part of the hay by half its quantity of a mixture of bran and oats, and roots were cut down in the case of Farm A to 14 lb.

Farm B, prior to this, was purchasing roots at 25*s*. per ton and hauling 4 miles, feeding 25 lb. per day, but these were discontinued at once; also a certain amount of hay was chaffed, and this was discontinued.

Farm A had also been feeding chaffed straw mixed with the roots but discontinued the chaff and fed the straw long.

The production ration consisted of the following:—

Farm A.	Decorticated cotton cake	1 part	feeding 3½ lb. per gallon
	Rice meal and oats	2 parts	
	Unextracted palm kernel cake	2 parts	
Farm B.	Decorticated cotton	½ part	feeding 3½ lb. per gallon
	Decorticated ground nut	½ part	
	Rice meal	2 parts	
	Unextracted palm kernel cake	6 parts	

also 3½ lb. soaked coconut cake in the form of thick porridge was fed for the first gallon in the case of Farm B.

The writers consider it preferable that half of the production ration should be in the form of cake and of large pieces for preference. The reason why these particular foods were used was that they were the cheapest at the time. Heavy milking cows for every gallon over 5 and heifers for every gallon over 4 were fed with 2 lb. linseed and ¾ lb. bran per gallon.

Results.—As an immediate result, all cows increased their yields and maintained them more evenly throughout the winter; all the cows kept evenly fleshed, and at the end of the winter, cows never went out to grass looking better. Probably one of the most important factors was the preparation of the cow for her lactation period. This was done by feeding a laxative production ration for 6 weeks before calving, commencing with a 1 gallon ration at the six weeks and increasing to a 2 gallon ration at the month. This resulted in the whole of the cows coming down at calving at least a gallon higher than at any other previous period, so much so, that if a cow comes in under 5 gallons, it is an exception.

For this ration when cattle are out to grass and also when the hay on the farm is laxative palm kernel cake is used. Indoors, when the hay is not particularly laxative, 2 parts linseed cake and 1 part rice meal are given.

Milk fever is not feared as precautions are taken before the animals are calved and on neither farm has there been a case of milk fever.

At the commencement of the system, daily recording was practised to see the effect of the rations on the individual cows and to increase the food to those increasing in yield. This also enabled the writers to keep a check on their milkers.

On going out to grass, Farm A had a slightly increased milk yield—about 7 per cent.—but Farm B had a decreased yield of about 6 per cent., part of which was later recovered. In both cases cows were turned out to plenty of grass about the beginning of May.

At the end of the year, Farm A had an increased average of 50 gallons per cow and Farm B of 120 gallons per cow; in the former case the herd had been recorded for many years, whereas the latter was newly formed and had only been recorded for three years. On Farm A it is estimated that the decrease on the cake and meal bill, after making an allowance for difference in prices, was over £150 during the year.

Modification and results in the Second year.—After the experience of 1922-1925, the writers were absolutely convinced of the effectiveness of the system, and preparations were made for the following winter by forward buying of feeding stuffs in collaboration with the organiser. During the last winter, more attention has been paid to dry matter by the cutting down of bulk of the maintenance ration, and in all cases the cows have been prepared for their lactations, this latter point being one that is most important. This preliminary feeding before calving is even more necessary for heifers than for cows, as is proved by the heifers in these two herds.

Also in the case of Farm A roots have been reduced to 14 lb. per day although there were sufficient on the farm to have fed 70 lb. per day.

With one winter's experience behind them and the men being more accustomed to the work and at last being converted, the results have been even better than the previous winter—to be precise, the daily average has been increased ½ gallon per cow.

On Farm A, the average number of cows (including dry cows and 17 heifers) was 75, and the average daily yield during the winter was 200 gallons. On Farm B, the average number of cows (including dry cows and 19 heifers) was 60; the average daily yield during the winter, 170 gallons. The ration for the last winter, owing to forward buying, cost 3*d*. per gallon. At the present moment (at the end of 7 months) there are in herd B as many 1,000-gallon cows as there were in the preceding 12 months.

Experiments have been conducted on three times milking on part of the herds, the results being ½ gallon increase per cow and 75 per cent. of cows responding. The effect was most marked on the heifers, some of which increased up to one gallon per day.

At the time of writing, Herd A has gone out to grass, and at the end of three weeks the yield is down 5 gallons per day. Herd B has only been out to grass three days, and the three times milked cows have shown a slight increase; these latter cows are kept in from 1 p.m. to 8·30 p.m., and have their cake ration for gallons over three during that period.

The system of summer feeding is:—a value is put to the grass (at present, 20th May, 3 gallons) and a balanced production ration fed for each gallon

over three. The feeding value attached to the grass is altered as the season advances. A small quantity of cotton cake is fed to prevent cows being too laxative. In the fall of the year, the grass will be balanced up to three gallons by a concentrated cake.

From the writers' experience of this system of feeding, they are absolutely convinced of the efficiency of the system and are very grateful to the organiser for his advice. They are certain that every dairy farmer will be well repaid for any attempt he may make to follow the system.

The writers would like to emphasise the fact that from their experience it is not a question solely of feeding a balanced ration according to yield, but it is by attention to minor details of management that the best results are obtained. As far as their experience is concerned, they are convinced that the feeding of chaff is detrimental, the heavy feeding of roots is not economical or desirable, and the order of feeding the various fodders and concentrates is of material importance. The importance of the order of feeding is to prevent, as far as possible, the animal overfilling herself, as one of the essential factors in the organiser's instructions is that the cow must not be overfilled. To get over this, the cake and meal is always fed before the bulky food, as, if this is done in the opposite order, the cow, being hungry, will eat a large bulk of hay and then consume cake and meal afterwards because she likes it, resulting in overfilling and a grunting cow; also, for heavy milking cows, three times a day feeding of concentrates is practised. The order, then, is as follows:—

5.30 a.m., 1/3rd cake and meal.

7 a.m., hay.

1 o'clock, 1/3rd cake and meal, followed by hay.

6 p.m., 1/3rd cake and meal, followed by hay.

Watering three times a day, the last watering being at 8 o'clock at night.

The value of watering at 8 o'clock at night cannot be overestimated.

Although the writers were the first farmers in Wiltshire to commence this system, it is common knowledge that a large number of farmers are now doing the same with similar beneficial results, and in some cases with even better results than their own.—The Journal of the Ministry of Agriculture, Vol. XXXI, No. 5.

FEEDING EXPERIMENTS WITH GROUNDNUT OIL CAKE.

W. DAVISON AND B. NARASHIMHA IYENGAR.

A series of experiments was made at the Rayankere Dairy Farm, with calves divided into two lots, one fed on wheat bran and the other on bran and groundnut cake, coarse fodder such as straw, green grass or silage being the same for all the animals. Records of the weights of the various groups were kept.

Results indicate that a mixed ration of bran and cake is preferable to either pure bran or pure cake fed seperately. It appears that in the early stages, the nature of the concentrated feed is not of such serious consequence as later.—International Review of the Science and Practice of Agriculture, Vol. II, No. 1.

SOILS AND MANURES.

COVER PLANTS.

T. PETCH.

The following notes are in continuation of those in this Journal for August, 1924.

Cassia mimosoides L. (Plate V. natural size).—Several forms have been included under this name in Ceylon. These differ notably in habit, some plants being erect or sub-erect and others prostrate, some having a few slender stems and others having stout woody stems and a shrubby growth. The last, which is the common form in the Kandy district, is now regarded as a distinct species, *Cassia Leschenaultiana*.—On the Uva patanas, a dwarf form is found, usually a single-stemmed or feebly branched plant, about six or eight inches high. The form which is suitable for cultivation as a cover plant is found in the Uda Pussellawa and the Knuckles districts; it grows over the surface of the soil in a flat mat, with a few sub-erect branches in the middle.

The stems are slender and up to 2 feet in length; they vary in colour from green to red-brown or reddish purple. Frequently only the upper side of the stem is coloured. The leaves are pinnate (feather-shaped), parallel-sided, up to 3 inches long, with very numerous, crowded, overlapping leaflets. There is a minute gland between the lowest pair of leaflets. The flowers are yellow. Although the plant belongs to the Leguminosæ in the old sense of the term, the flower is not pea-shaped, but cup-shaped, with five similar petals. The pod is comparatively long and slender. The whole plant is covered to a greater or less extent with short golden hairs. When these hairs are especially numerous, it becomes variety *auricoma*.

As already noted, *Cassia mimosoides* flourishes best, as far as is known at present, in the Uda Pussellawa district and the Knuckles. When grown at Peradeniya it dies out in two or three generations. The plant is an annual. *Cassia Leschenaultiana* which grows well at Peradeniya is too shrubby to prevent soil erosion and not shrubby enough for a green manure.

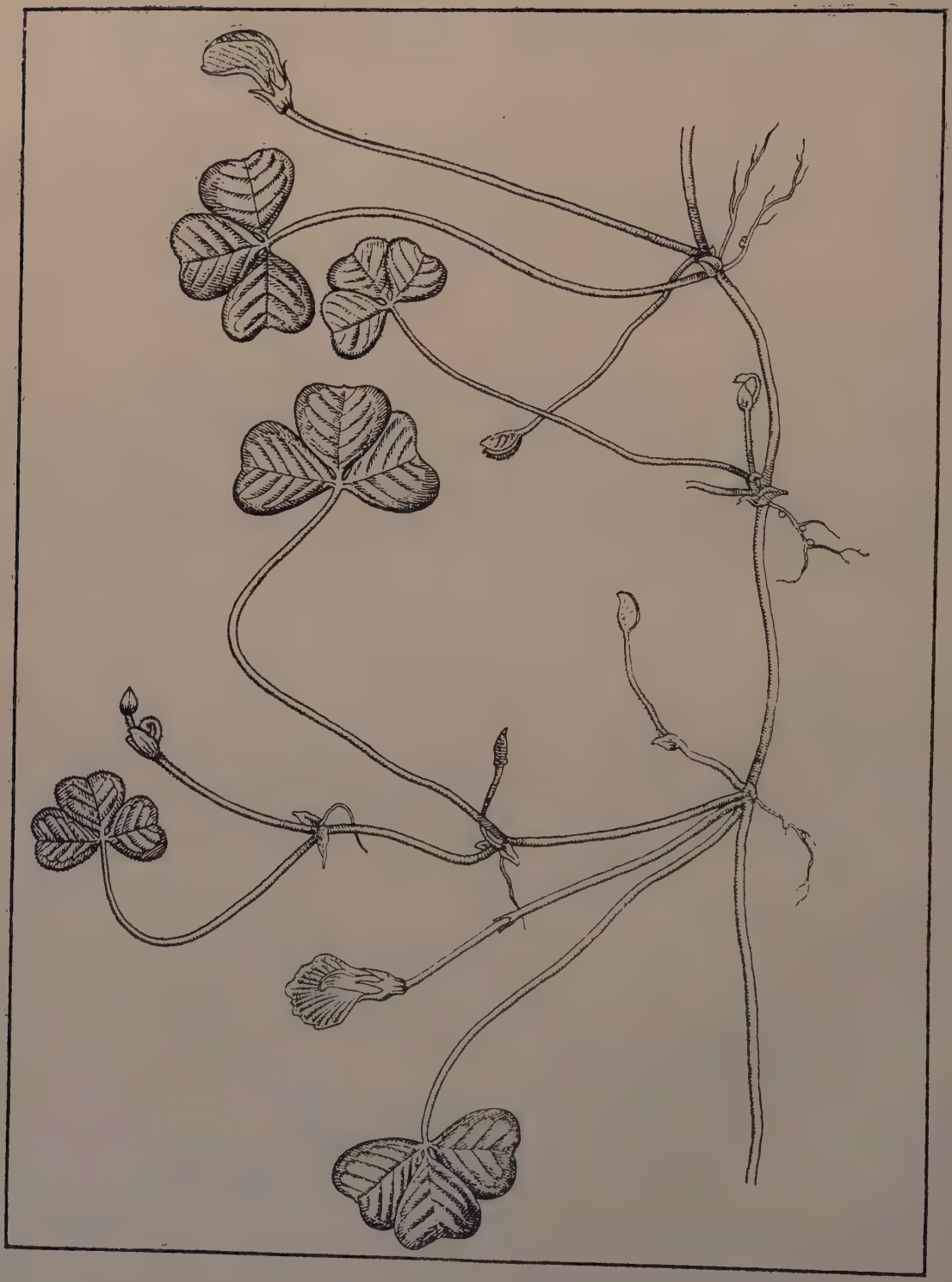
Some years ago, *Cassia mimosoides* was brought from India as a green manure. The plant introduced was an erect form. It did not flourish at Peradeniya, and died out in the third generation.

The Sinhalese name of *Cassia mimosoides* is Bin-siyambala, the ground tamarind, from the resemblance of the leaf to that of the tamarind (siyambala), but this name is also applied to other similar species.

Parochetus communis Hamilt. (Plate VI.). This plant has been recommended in South India as one of local plants which could be grown to prevent soil erosion. It occurs in Ceylon from an elevation of 4,000 feet upwards, and is fairly frequent on shady banks, or at the base of hedges, round Nuwara Eliya. It is a creeping herb, with a long prostrate stem which spreads for a considerable distance over the ground, rooting at intervals. The leaves are scattered, and are three-foliate, resembling clover leaves. The plant belongs to the Leguminosæ, and has pea-shaped blue flowers, which are borne singly on slender stalks.

CASSIA MIMOSOIDES.

Plate VI.



PAROCHETUS COMMUNIS.

The general appearance of *Parochetus communis* in Ceylon suggests that it is too tender to withstand the wear and tear of a tea estate. That, however, should not deter any one from experimenting with it, as the same would be said, *a priori*, of *Oxalis*. It certainly appears to tolerate shade.

As an addition to the notes on *Desmodium* published in the August number of this Journal, it may be noted that both *Desmodium triflorum* and *Desmodium heterophyllum* grow in Maskeliya.

STORING MANURE.

The following extract is taken from the *Journal of the Jamaica Agricultural Society*, Vol. XXVIII, No. 4

Few people seem to appreciate the value of bush, leaves, chips of wood, brambles, etc., as a valuable manure for any soil. Anything that fire will burn, as a rule, makes good manure,

The hole need not be very deep, say 2 ft. and it can be as wide and as long as the space will allow, or according to the amount of bush that can be stored. The excavated earth may be banked round, and the hole will then be about 4 ft. deep. On the whole it is a better plan to have two such "compost" holes as they are called, of equal dimensions, one to be filled, and while that is rotting, the other can be used. Into these holes will go all the sweepings from the yard, all the trimmings of leaves, any waste water and even ashes from the kitchen if scattered about, not thrown in heaps. Cows, Horses, Goats, Pigs or any other animals, can be tied out right on the rubbish. It is only necessary to spread fresh bedding on the bush at nights. There will be no smell or anything objectionable. Tying out animals, especially the bigger animals on these heaps is useful in more ways than one. First, the droppings are all collected in the litter and the liquid part, which is the hardest to keep, does not waste. Second, these compost heaps, kept level and rammed tight, are less likely to lose the nitrogenous portion, which is the most important to us here. If the heap is closely compressed, the loss is largely checked, and possibly is reduced to the minimum. The heap can be filled right up above the level of the sides of the hole. Having gone down 2 ft. deep and thrown up the loose earth round the sides you have made a pit which as has been stated, is four feet deep and you will fill it up about five feet, for it is bound to subside. However, it is wise to go as high as you possibly can.

After that heap is filled, take up the next heap, and treat it in the same way. It is possible to start using heap No. 1 immediately, but it is better to allow it to rot for about 2 to 3 weeks.

It must be understood that there is a certain amount of loss after a few months of storage but this would hardly be noticeable.

These holes should have the bottom and sides well rammed so that they might hold water as the liquid portion of the manure which is the most valuable, is liable to be lost by seepage if this is not done. Furthermore, the manure heap should have a cover to preserve it from rain and sun. A few posts and rails and thatch roof provide this covering which should be high enough to use also as a shelter for beasts.

L. L. C.

PESTS AND DISEASES.

WITHER-TIP OF LIMES IN DOMINICA.

F. STELL,

Mycologist of the Department of Agriculture.

By an arrangement between the Colonial Office, the Dominican Government, and the Trinidad Government, the writer paid two visits to Dominica during the last six months. Altogether some eight or nine weeks were spent in the Island investigating the disease called "wither-tip." The growing of limes constitutes the only agricultural industry of commercial importance in Dominica.

The lime growing areas occupy some five to six thousand acres. They are planted in a variety of situations. There are coastal properties at intervals practically throughout the Island. Many of the estates are in valley areas; others are established in "flats" or "pockets" usually at a good elevation; and others again in the interior of the Island.

The whole of these estates have been developed during the last forty or fifty years following the collapse of the sugar-cane industry. Practically all the trees have been planted much too close, the average spacing being 12 to 20 feet but less than 20 feet on the average. Such spacing prevents the proper growth of the trees and makes it almost impossible to handle them effectively when a disease such as "wither-tip" is present. In addition, it is necessary to note that the land in Dominica is very rugged, making access to the cultivations very difficult in many places. Under such conditions the industry has been built up; soil and weather conditions being very favourable in certain localities for the growing of limes.

The average annual crop for some years previous to the outbreak of "wither-tip" in 1922 was 400,000 barrels, or about 70 barrels per acre. This is a very low figure when one takes into consideration the average cropping of good lime trees.

THE GOVERNMENT LIME PLOTS.

About 12 years ago the Agricultural Department in Dominica, under the able direction of Mr. J. Jones, the Curator, set out a series of experimental lime plots. The land was hill-slopes in a semi-exhausted state, having been abandoned by peasants who had grown provisions. Contour drains were established, mulch plots started, and the lime trees reasonably well spaced. Prior to the advent of "wither-tip" the cropping was in the region of 350 barrels per acre. It must be observed that the plots being experimental various artificial manures were used and records kept of the crops from the various plots. But the addition of mulches (guinea-grass, lemon-grass, etc.) has in itself been demonstrated to be markedly efficient in promoting and maintaining the health and vigour of the trees and in giving high yields. The great lesson to be learnt from these plots is that when the lay-out is good, cultivation steadily and continuously pursued results in each and all the trees being economic, *i.e.*, paying trees. They bear big crops; in fact, on the average, they yield five times more crop than those of the average estate. Hence when disease arises which requires spraying or pruning or other treatment, good trees will pay to treat and still yield a substantial profit.

"WITHER-TIP" THE CAUSAL ORGANISM AND ITS DISTRIBUTION.

The "wither-tip" fungus is one of the anthracnoses, *Glœosporium limetticolum*, Clausen. It is a microscopic plant parasite and when the climatic conditions are favourable to the fungus it can do great damage. The parasite confines its attack to young tissues, shoots, leaves, flowers and fruits. And the lime tree being very elastic in its flushing and blossoming makes the control of "wither-tip" extremely difficult and expensive, because it involves the constant protection of young tissues by a spray deposit.

The fungus is readily conveyed from estate to estate on the clothing and implements of labourers especially in Dominica where labour is very mobile. Birds and insects also play a part in distributing the parasite; and no doubt heavy showers of rain are effective in washing the fungus from one part of the plant to another and from one plant to another.

GENERAL CONCLUSIONS.

The fact being established that "wither-tip" is a serious parasite of limes under certain conditions it is necessary to determine if that is the case under all conditions. Investigation of the trouble in Dominica shows that the parasite varies greatly in its virulence in different parts of the Island. In the valleys, many of which are narrow, and in the interior, great damage has resulted, the cropping nowadays being practically negligible in some places. Dominica shows great range of variation in rainfall, temperature, sunshine, and wind. The rainfall varies from 50 inches on the leeward side to 280 inches in parts of the interior. Between these extremes there are a series of gradations; similarly temperature varies with altitude, and sunshine varies in relation to the contour of the land. Thus it comes to this: that there are large sections of limes planted in areas of low rainfall which receive a maximum amount of sunshine; the trees are located on sunny slopes; and wind-action is appreciable on these scattered sites. This constitutes a class of cultivation existing under comparatively dry atmospheric conditions. Under these conditions the lime industry should continue to be remunerative, and the return will be in proportion to the amount of good cultivation practised. A second class is made up of estates mostly in valleys, where heavy dews are prevalent and where sunshine is fitful. In this group it is doubtful if lime cultivation with the existing susceptible variety will be profitable in future. Lime estates in the interior of the Presidency and some other properties nearer the coast represent a third class in a zone of high rainfall. These properties have never been paying propositions since their inception and now the "wither-tip" fungus has done great damage in them because the atmospheric humidity is very high and the parts of the trees susceptible to the parasite are rarely ever dry.

It follows, then, that it is of the first necessity carefully to survey estates; to determine where the damage is relatively little; and to throw out of cultivation the sections which always carry considerable moisture. This really means selective cultivation. Many of the drier sections can be improved by thinning out the trees and reducing shelter to a minimum so as to permit better access of light and air. A policy of this kind would promote a drier atmosphere about the lime trees and thus the fungus would have less scope to infest the cultivations.

The West Indian Lime, *Citrus medica* var. *acida*, forms the one kind of lime grown commercially in Dominica and in the Caribbean area generally. It has proved to be a most excellent crop for the greenlime trade and also for high citric acid yield, but is very susceptible to "wither-tip." There are a number of varieties of limes known to be immune to "wither-tip" in various parts of the tropics. Work is proceeding in Dominica to introduce and test several of these immune varieties and it is hoped that a variety or varieties will be found to equal or approximate in bearing qualities and acid contents to the present susceptible kind. This is a big task and will take several years to work out.

The general conclusions are that it should be possible to prosecute successfully the existing lime industry in certain sections of the Island providing careful and continuous cultivation is maintained; the substitution of immune varieties by experimental methods should be pursued; and alternative crops can be profitably introduced.—Proceedings of the Agricultural Society of Trinidad and Tobago, Vol. XXIV, Parts 4 and 5.

HURRICANES AND COCONUTS.

LEO. A. WATES,

Agricultural Instructor, E. Portland and E. St. Thomas.

Experience seems to show that the after-effect on coconut trees of a hurricane is a large loss of trees from a rotting of the bud or growing point. This in its last stages comes under the heading of Bud-rot, as dealt with under the Plant Diseases Law.

It would appear that this Bud-rot is of very slight danger to the coconut industry if kept under regular watch and control during the long periods that usually pass between hurricanes, and only becomes a menace if carelessly neglected *after* a storm.

The most rapid, and least easily recognized kind of Bud-rot that attacks the bud first and destroys the growing point whilst the rest of the tree remains upright in limb and green, is that kind chiefly referred to in these remarks, and most prevalent after hurricane.

Before the hurricane of 1903 very little was thought of or known about this trouble, with the exception of the attacks on trees down at Bluefields and in that direction, which in after years knowledge would appear to have been the other more slowly developing Bud-rot that starts at the base of the butts of the main limbs from the bottom and on the blossoms.

After 1903, however, there was a general outbreak of Bud-rot in the heart which owing to their being no Law to control it, became rather widespread and was causing serious losses, chiefly because planters did not know what the trouble was and were loath to destroy trees till they became actually dead, and were a standing threat to other trees around.

After the passing of the Law in 1915, and its being put into serious operation after 1917 hurricane, when there was a fresh outbreak, and the destruction under that law of something like 80,000 trees, the disease was checked, and practically eliminated, only a rare case being found here and there.

Up to quite lately there has been a good deal of confusion and wrong diagnosis by planters, mixing up leaf-bite disease and But-rot. Many imagined-cases of Bud-rot which have recovered, have really been Leaf-bite, and if not that, are most probably caused by the boring beetles destroying the embryo bud. No case of recovery from actual Bud-rot is known.

The conclusion, therefore, must be that Bud-rot here is *largely* the after-effects of hurricane damage developing into the disease because of *neglect* and it certainly does appear that if all planters would take immediate steps to deal with their coconuts after a hurricane the percentage of loss would be very largely reduced.

Each year the hurricane that is brewing for the Island in the future comes nearer, and therefore a reminder of necessary operations will not be inopportune.

It was proved by Professor Ashby, the late Govt. Microbiologist, that Bud-rot was caused by attacks of fungi either at the bud or at base of limbs, or on blossoms, which later developed into a stinking bacterial and hopeless decay.

The effect of hurricane on the crown of coconut trees as observed in St. Thomas, Portland and Hanover, shows the following may happen :

(1) The limbs of the whole crown may be raggedly snapped in half and kept hanging by shreds.

(2) The upright heart leaves may be given a special twist or broken off.

(3) The cabbage part of the heart may, whilst not wholly broken, receive a fracture low down near bud.

(4) The whole heart may be wrenched over to one side, though not broken off or detached.

The actual total destruction of the heart does not come under review here. The outstanding effect of these various occurrences after hurricane, to the heart, is to cause a number of wounds and open sores. This immediately lays the tree open to danger from 3 sources—(1) the danger of water soak of wounds, (2) the danger of beetle attack in wounds, (3) the most serious danger of attack from fungi in open sores. The astonishing attacks made by beetles or weevils on trees was very apparent in Hanover visited by writer some months after 1912 hurricane, when trees were found positively seeded with the cocoons of larvæ from beetle. These larvæ bore channels up the inside of limbs, and leave a splendid entry for fungi of different kinds.

If this conclusion, therefore, is recognized, then it follows that the wisdom of immediate action to protect the injured portion of tree goes without question. The following therefore should be carried out, if possible within the same week of the storm :—

(1) Every heart of a coconut should be visited by a climber, all broken limbs trimmed off, and heart of tree pruned back to wherever it is broken or twisted.

(2) All exposed portions of limbs, etc., should be tarred wherever possible.

(3) A quart of strong jeyes and water should be poured into each heart. This remedy has been laughed at by some scientists, nevertheless, practical experience has shown it is effective in destroying beetles and insects, and trees known to be attacked by beetles have recovered after this.

(4) Immediately after, a quart of a mixture of blue stone and white lime made of 5 lb. blue stone, 5 lb. lime and 20 gallons of water should be applied in each heart.

(5) Three weeks or a month later a second application should be made.

(6) All wounds on trunk should also receive a dressing of tar.

All this is very simple, the crux of the whole matter however is immediate, right away attention. If this is seen to, there will not be a serious outbreak of Bud-rot or the need for destruction of 80,000 odd trees again. —The Journal of the Jamaica Agricultural Society, Vol. XXVIII, No. 6.

BANANA BUNCHY TOP DISEASE.

The Minister for Agriculture and Stock (Hon. W. N. Gillies) has made available a report of investigations of the Bunchy Top disease of bananas made conjointly by Dr. Darnell Smith (Vegetable Pathologist of the New South Wales Department of Agriculture) and Mr. Henry Tryon (Vegetable Pathologist and Government Entomologist, Queensland). The disease has spread across the border into the south-eastern corner of this State and is causing much loss to growers and concern to departmental officers. Both officers visited the affected border areas and studied the malady from every angle and noted local remedial measures and experiments. Notwithstanding close observations and the knowledge of affecting facts no definite exclusive cause of the disease was discovered. Further, they concluded that the explanations with reference to its origination in the individual plant, put forward without—as far as could be ascertained—positive experimental evidence of a conclusive nature had not advanced their knowledge of the subject. However, the New South Wales investigations and especially its field experiments directed to definite phases of the question, would, as far as they had proceeded, appear to have narrowed the inquiry materially ; suggesting, as they did, that certain theories put forward to explain the incidence and mode of action of banana bunchy top had now to be dismissed as untenable.—Editor, Queensland Agricultural Journal.

Theories relating to the following possible agencies in promoting plant sickness were investigated :—

1. Soil Depletion, by the Loss—to Some Extent Absence—of Essential Banana Plant Food Constituents in it.

Fertiliser field experiments have rendered it evident that the use of complete fertilisers of varying constitution, as well as fertilisers providing a single essential plant food requirement, do not prevent the occurrence of the disease, either in soils relatively rich or in ones relatively poor, as ordinarily understood.

[Note.—These experiments, which have been conducted on proper lines, have, however, not so far related to humus-producing fertilisers nor covered the entire range of soil-types.]

2. Loss of vigour in Banana Plants—*e.g.*, by the Continuous Use of Banana Plants of a Single Origin.

Although the general habit of the plants in which the disease may manifest itself, including such plants as receive fertilisers as a field routine procedure, and although the high quality of the banana fruit that the district generally yields, would appear to be conclusive as to the "strain" of plants generally grown not having developed weakness, and so disease, this factor—hypothetical impairment of stamina—has not been lost sight of. It has now been shown experimentally to be non-operative by the manifestation of the Bunchy Top disease in plants introduced into the affected area from remote districts in which there has been no history of the occurrence of the malady, equally with those of local origin. One of these experiments, in which banana corms were obtained from north of Cairns, Queensland, covered no less than ten distinct field plots in the Tweed District.

3. Soil Acidity.

The factor of soil acidity, which might be presumed to operate in promoting the occurrence of disease, has been the object of test experiments with so far negative results. Ant-acids applied to the soil, whether in the form of lime or basic phosphates, having failed to protect plants from the disease occurrence—even ones introduced from "clean areas."

4. Soil Contagion.

Field experiments have again shown that the disinfection—by one or other fungicides—of suckers in planting, and simultaneously that of the soil with which they are brought in contact, does not prevent the occurrence of the disease in plants derived from such suckers.

5. Definite Parasite Action.

Again, investigations have so far failed to reveal the presence of a fungus-organism or of fungus-organisms capable of originating Bunchy Top under experimental conditions, although certain ones, included in groups in which undoubted plant parasites occur, have been met with by one of us. (The inquiry, however, is still in progress.)

6. Animal Parasites.

A nematode causing plant injury that we have commonly found in connection with the roots of Bunchy Top affected plants, not being invariably found to occur in this association, cannot be the exclusive cause of the malady. That any insect is inculpated has not been shown definitely to be the case.

[Note.—Some notoriety has attached to the pronouncement that a particular insect—the Banana Aphis (*Pentalonia nervosa*)—serves as the communicator of the disease between one plant and another, or even is its prime cause in healthy plants, and although general observations do not favour the explanation a remedy involving this insect theory is being tested in the New South Wales portion of the infected area.]

7. Climatic Factors.

The prejudicial effects of meteorological conditions unfavourable to the growth of the banana plant, those only gradually manifested in the course of years, cannot be settled by direct experiment. It appears, however, to be interdicted by what is known regarding the geographical range of the Cavendish and of other banana varieties, not only in the Tweed area but elsewhere. In regard to the former, there is evidence that in the past an abundant yield of good fruit has been raised from healthy plants for eight or ten successive years.

8. Climatically Injured Soil Conditions.

No evidence as to the nature of the change spontaneously produced in the soil under banana crops, since its adaptation from its original condition as a scrub or forest soil to this cultural use was obtained. This is a matter amongst others that it is proposed to be inquired into.

9. Prevention and Cure.

Both these are dependent on a knowledge of the cause of Bunchy Top disease or must have relation therewith. Not knowing the cause they cannot be predicted, and moreover we have not sought to discover them by empirical procedure conducted in this respect in the dark.

10. Further Research.

Further scientific inquiry on the cause, prevention, and cure of Bunchy Top disease is still called for. This inquiry should embrace both field and laboratory experiments and research. The bestowal of the fullest measure of scientific thought and endeavour in respect to the disease is urgently necessary.—Queensland Agricultural Journal, Vol. XIX., Part 1.

"BUNCHY TOP" IN BANANAS.

G. P. DARNELL-SMITH,

Biologist.

This disease has had a disastrous effect upon many plantations in the Tweed district, and some plantations on the Richmond River have become affected. By the importation of healthy corms from healthy districts, it has been demonstrated that the disease is not due to a "running out" of stock. Further analyses of soil from around healthy and unhealthy plants have been made, and further manurial trials have been carried out. From them it does not appear that the disease is due to the lack of any ordinary soil constituent. The suggestion that the disease is carried by aphides has been tested out, and while spraying plants with kerosene emulsion has kept these pests down, and has apparently to some extent minimised the amount of the disease, it has not yet brought it under control.

Timely action should be taken on the lines recommended by Mr. W. J. Allen, Fruit Expert of the Department, when infection is noted on a small scale, affected plants being completely cut out, and the holes limed and not replanted. The plants cut out should be taken well away from the plantation, and, if possible, completely destroyed by fire.—Agricultural Gazette of New South Wales, Vol. XXXIV., Part 12.

THE EFFECT OF WEEDS ON PADDY.

In the Philippines, de Peralta and Estioko have investigated the effect of weeds on paddy by determining the yields of paddy which received drainage water from cultures of paddy, Diya-habarala (*Monochoria hastaefolia*), Pan (*Cyperus* spp.), and Layu (*Leersia hexandra*). The latter is a weed in muddy places in Ceylon, but is the most common fodder crop in the Philippines.

Their results indicate that Diya-habarala and *Cyperus* spp. excrete substances which are beneficial to the growth of paddy, while the excretions of Layu are detrimental, and, to a lesser extent, those of paddy itself. It is thought that if Diya-habarala or *Cyperus* spp. were grown in rotation with paddy, increased production of grain would be obtained. On the other hand, Layu should not be grown in rotation with paddy, though thorough ploughing and harrowing before planting the paddy would probably modify the injurious effect of its excretions.

A PEST OF SWEET POTATOS.

"I have a boring pest which eats into my sweet potatos. I am sending to you in a bottle some small beetles which I think are the adults of the grub that causes the trouble; they were always found sheltering under the potatos that were left on the ground after digging. What is the best method of control?"

The writer of the foregoing was informed that the specimens forwarded were those of the sweet potato weevil (*Cylas formicarius*), the larvae of which tunnel almost exclusively in the sweet potato tubers and a few other closely allied plants. Although winged, its power of flight is limited, and the spread of the pest is largely caused by transportation of infested tubers or plants, which should therefore be obtained from localities known to be free from weevil.

Clean cultivation will help considerably in reducing the damage. Infested fields should be cleaned up promptly, and all stems, tubers, and other remnants burnt and the land kept free from "volunteer" potatos. The potatos should be harvested promptly and all infested tubers separated from the others, those that are too badly damaged being cooked for stock or burnt. Rotation of crops is also desirable; the same land should not be used year after year where weevils are present, and the new crop should always be planted well away from the neighbourhood of the seed-bed.—T. Mc Carthy, Assistant Entomologist, in Agricultural Gazette of N. S. W., Vol. XXX, Part 2.

CEYLON AGRICULTURE.

ESTATE PRODUCTS COMMITTEE.

Minutes of the twenty-first meeting of the Estates Products Committee of the Board of Agriculture held at the School of Tropical Agriculture, Peradeniya, at 2·30 p.m. on Thursday, September 11th, 1924.

Present:—The Acting Director of Agriculture (Chairman), the Acting Government Botanist and Mycologist, the Government Entomologist, the Acting Government Agricultural Chemist, the Hon. the Government Agent, C. P., the Acting Government Veterinary Surgeon, the Divisional Agricultural Officer, C. D., Dr. W. P. Rodrigo, Messrs. H. D. Garrick, J. B. Coles, J. E. P. Rajapakse, A. S. Long Price, R. P. Gorton, H. L. De Mel, N. G. Campbell, J. W. Oldfield, E. W. Keith, D. S. Cameron, C. C. Durrant, N. D. Stephen Silva, J. Horsfall, A. Coombe, J. S Patterson, A. T. Sydney Smith, E. M. Windus, R. F. Battams, H. W. Gavin, C. C. du Pre Moore, O. Balean, and H. A. Deutrom (Acting Secretary).

As Visitors:—Messrs. Chas. Gibbon, N. K. Jardine, R. O. Iliffe, A. W. R. Joachim, R. V. Routledge, Hew Kennedy, Huntley Wilkinson, G. Trevaldwyn, E. E. Megget, and J. A. E. Price.

Letters and telegrams regretting inability to attend were received from the Hon. the Controller of Revenue, the Hon. Mr. Felix Dias, Messrs. L. A. Wright, G. W. Hunter-Blair, James Peiris, J. W. Scott, T. Y. Wright, E. Maberly Byrde and A. F. B. Smeaton.

The minutes of the previous meeting having been circulated to members, were confirmed.

Item. 1.—Progress Report of the Experiment Station, Peradeniya.

The Chairman explained that owing to the Secretary's enforced absence the progress report could not be circulated to members previous to the meeting.

Summarising the report the Chairman drew attention to the poor cacao crop and the large percentage of diseased pods due to continuous rain during August and into September. He said that Phytophthora was found at Peradeniya on rubber pods this year for the first time.

Hoof and mouth disease had broken out amongst the cattle on the station and in consequence the work had been interfered with.

Mr. H. L. De Mel asked what method was employed in planting the 24 coconut plants referred to in the report.

The Secretary said that the nuts were all planted vertically.

Mr. Oldfield, referring to the note on planting *Indigofera endecaphylla*, said that he obtained 90% successes by planting in the ordinary way. The Chairman said that might depend on the climate and the rainfall. The ordinary methods of planting cuttings did not seem to have answered at Peradeniya. Mr. Holland, the Manager, had tried a particular method with good results, which seemed to indicate that the best propagation was secured when the cuttings rooted at the nodes.

Cuttings of *Desmodium triflorum* had been put out in that way but had not proved successful.

The Chairman read two letters he had received since the last meeting, one relating to the sale of Arghan plants in the F. M. S. and the other from Mr. S. V. S. M. Perez, Erode, India, regarding bone manure. Mr. H. D. Garrick enquired whether the Department was going to buy any of those valuable plants. The Chairman said that there were 100 plants at the Experiment Station, Peradeniya, and he thought that was sufficient.

Item 2.—Cacao Manurial Experiments.

Mr. Keith stated that at the last meeting, exception was taken to the general manure advised for the cacao manurial experiments. In particular, the inclusion of Sodium nitrate was criticised and it had been stated that it would be better to employ slow acting manures. Mr. Keith was of opinion that a certain amount of a soluble quick acting manure was necessary to assist the trees at the time the crop was being formed. The manure in question had been in use on Kondesale for fifteen years, and the average yield during that period had been 6 cwt. per acre. Mr. Neil G. Campbell supported Mr. Keith's statement regarding the crop on Kondesale.

Mr. Bruce reviewed the previous scheme of manuring on these plots, which were designed to ascertain the effect of lime with and without nitrogenous manures, and urged that the quantity of lime applied had been excessive. He considered that no further manuring with artificials should be done on these plots until the effect of the lime had been eliminated.

In reply to Mr. Keith, Mr Bruce stated that in his opinion slow acting manures were preferable to quick acting manures for cacao, and that Ammonium sulphate was to be preferred to Sodium nitrate. He was unable to agree that cacao required a quick acting nitrogenous manure at the time of formation of the crop.

Mr. Gibbon directed attention to the previous history of Kondesale. After further discussion, it was decided to discontinue manuring these plots for a year.

Item 3.—Nitrate of Soda as a Manure for Tea and Rubber in Ceylon.

Mr. Oldfield stated that Nitrate of soda was largely used in this country and had been frequently recommended by experienced planters. With reference to the sample of a manure mixture exhibited at the previous meeting, he enquired whether Nitrate of soda was more hygroscopic than Nitrate of potash. He understood from Mr. Bruce's remarks that he condemned the manuring of rubber because it was a slow-growing tree: he submitted that it was a quick-growing tree and there was general agreement among planters that manuring of rubber was advantageous on most Ceylon soils. He was convinced that nitrogen occupied the first place in the nutrition of the rubber tree.

Mr. Bruce dealt with the effect of nitrate of soda on tea, and showed by the results of an experiment given in graph form that the effect of sodium nitrate died out within a month of application. He remarked that the published results regarding sodium nitrate were obtained in countries where the rainfall was small when compared with that of Ceylon, and that they related to quick-growing annual crops. He then described the hygroscopic qualities of various manures.

Mr. Bruce stated that he had not condemned the manuring of rubber, but had recommended the use of slow-acting manures. He contended that excessive nitrogenous manuring rendered the trees more liable to disease.

The Chairman said that there was no doubt that excessive nitrogenous manuring increased the amount of leaf disease in tea and coconuts. The earliest manuring of tea in Ceylon was nitrogenous manuring,—manuring for leaf; and it was followed by bad attacks of leaf disease in the nineties. It was then that Grey Blight and Brown Blight were first recognised as diseases in Ceylon. A short time ago, a Japanese scientist connected with tea cultivation visited Ceylon; in course of conversation he said that Grey Blight was a very serious disease in Formosa and wanted to know how it should be treated. He was informed that in Ceylon, Grey Blight was not serious if the tea was manured and cultivated, whereupon he replied that in Formosa manuring made the disease worse, and on enquiry it was found that the manure applied was night-soil.

Naturally the effect of nitrogenous manures would be likely to vary with the disease. As regards *Phytophthora* in rubber, no data were available, but observations were being made by the officers of the Rubber Research Scheme. In 1922, manuring experiments were begun in India to determine the effect of manuring on pod disease and abnormal leaf fall. In 1923 it was stated that these had proved disappointing, but no details had been published. Nitrogenous manuring made the leaves a darker green and delayed the normal leaf fall, but its effect on the abnormal leaf fall was not yet known. The darker green produced by nitrogenous manuring was not necessarily a sign of health, and in the case of some diseases it denoted an increased susceptibility.

Manurial experiments on the effect of sodium nitrate on yield had been carried out in Java. These have shown a favourable result only on a peculiar white, cementing soil. On ordinary red soil, sodium nitrate had no effect. The Chairman stated that the results of these would be summarised in the *Tropical Agriculturist.*

In response to a query by Mr. Patterson, Mr. Bruce stated that Nitrolim was not hygroscopic ; it was as " dry as a lime-kiln."

Item 4.—Helopeltis on Tea and Best Methods of Prevention.

Mr. Patterson in introducing this subject said that Helopeltis in tea was very bad this year in Morawak-korale, especially prevalent on poor tea. He enquired whether the Department could recommend any special treatment.

Dr. Hutson said it was found sufficient to collect the insects in ordinary attacks. In more serious outbreaks the only possible method of control would be spraying but this obviously was impracticable over extensive areas. No very satisfactory methods have been tried over large areas. He thought that by improving the condition of tea it would be possible to bring it under control.

Mr. J. B. Coles said it was very bad in Morawak-korale but it had been kept under control by stripping the bush—two rounds,—though he understood from Dr. Hutson that the insects after a time got lower down into the bush on to the hard-wood.

Dr. Hutson said they found it so in India. As a general rule improved methods of cultivation helped the bushes to resist attack. Nothing definite was known or proved as yet. In India they had it almost continuously through the year except in cold seasons. Heavy plucking seemed to have no effect in India. It was noticed that the insects attacked the bush lower down the stem and below the plucking level.

Item 5—How Often Should Deep Ploughing and Harrowing be Done on Coconut Plantations.

Mr. H. L. De Mel said that in the drier districts they were accustomed to ploughing and harrowing regularly. This had been done for 7 or 8 years. It was found that this practice was most satisfactory in the eradication of illuk. Some estates had used the plough rather freely with the result that the roots had been badly cut and the general condition of the estate tended to depreciate. There was no doubt that deep ploughing had its uses, but he questioned whether this practice if too frequently carried out would have disastrous results. He said he would, however, like to have that question answered in the light of the experience of other members.

Mr. J. E. P. Rajapakse enquired how deep Mr. De Mel ploughed his land. Mr. De Mel said about 3 or 4 inches.

Mr. De Mel said this was done in young plantations. He had employed elephants once for deep ploughing but abandoned that on the advice of Mr. Long Price.

Mr. Rajapakse thought that harrowing was necessary only after the monsoons to conserve moisture.

The Chairman remarked that harrowing must be done with reference to the depth of the roots.

Item 6.—Fodder Grass Trials at the Experiment Station, Peradeniya, for 1923–24

The Chairman briefly reviewed the return circulated to members. He said that there had been a decrease in yield from the first to the third year. It had been decided to give up Rhodes-grass at this elevation and continue with Paspalum and Guinea-grass.

Item 7—Relation of Tea Soils to quality.

With the permission of the Committee Item 7 was postponed to another meeting.

H. A. DEUTROM,
Acting Secretary,
Estates Products Committee.

FOOD PRODUCTS COMMITTEE.

Minutes of a meeting of the Food Products Committee of the Board of Agriculture held in the Legislative Council Chamber at 12 noon on Wednesday, August 27, 1924.

Present.—Mr. T. Petch, Acting Director of Agriculture (Chairman), the Hon. Sir H. M. Fernando, Kt., the Hon. Mr. J. H. Meedeniya, Adigar, the Hon. Mr. H. L. De Mel, Mr. C. Drieberg, Gate Mudaliyars A. E. Rajapakse and M. S. Ramalingam, Mudaliyars G. Gunatilaka and W. A. Amarasekera, Mr. S. Muttutamby Adikar, the Divisional Agricultural Officer, Central Division and Mr. N. Wickramaratne (Secretary).

Before proceeding with the business of the meeting, the Chairman said that he regretted to have to record the death of the late Mr. A. Sabapathy, a member of this Committee, who took a great interest in agriculture in the North and promoted its interests admirably. He moved that the Committee do pass a vote of condolence. The vote was passed in silence, all the members standing.

The minutes of the meeting held on August 14, 1923, were confirmed.

Agenda Item 2. Reports on "Kudumetta" Weed.

The Chairman said that as agreed on at a previous meeting, reports on this weed had been obtained from the Agricultural Instructors who were asked to ascertain whether "Kudumetta" occurred in paddy fields in their districts, what steps were taken to eradicate or control it, and whether these had been successful. Their reports varied according to the different districts. Some stated that the flooding of the fields would check the weed, others said that the weed occurred where there was very little water. Jaffna reported there was no "Kudumetta" which meant they had no weed by that name. The Chairman said that the Agricultural Instructors had now been asked to send specimens of weeds from paddy fields in their respective districts so that these might be identified. Afterwards it might be possible to carry out experiments to ascertain whether any treatment could control or eradicate them.

Messrs. Meedeniya, Goonetilake, Ramalingam, Sir Marcus Fernando, and Mr. Auchinleck (the Divisional Agricultural Officer, Central) took part in the discussion that followed.

Mr. Meedeniya said that if fields were cultivated systematically and annually flooded there would be no Kudumetta.

Sir Marcus said that if fields are cultivated twice a year there would be no chance for weeds to grow.

Mudaliyar Goonetilake remarked that there were fields which could not be cultivated twice.

Mudaliyar Ramalingam said that fields in Jaffna were properly weeded and were kept clean, and no weeds are allowed to grow.

Mr. Auchinleck remarked that in certain districts the weed grew very tall and in certain other districts it was very small.

The Chairman said that all that could be done at the present time was to go further into the matter by ascertaining exactly what the name Kudumetta meant in each district.

Agenda Item 3. Sunn Hemp trials at Nalanda.

Mr. G. G. Auchinleck (Divisional Agricultural Officer, Central) tabled a statement showing results of Sunn Hemp trials in paddy fields at the Experiment Station at Nalanda for the Yala season 1923. Each plot selected for the trial was 1,000 square feet in extent. There were 21 plots, aggregating to 21,000 square feet, or half an acre in all. The trials were undertaken to find out the value of the plant as a green manure for paddy and the results were satisfactory. The yield varied from 94 to 564 pounds per plot, or, when calculated the relative yield per acre, from 4,095 pounds to 24,560 pounds. Where the plants were buried in trenches in the field the paddy grown was extremely healthy.

Several members took part in the discussion.

Sir Marcus Fernando said he had seen the plant grown in Chilaw and Kurunegala districts in low lying lands, and it was a valuable green manure.

Mr. Meedeniya enquired the average yield of fibre per acre, and Mr. Auchinleck stated that in India it was 500 pounds, but no definite figures were available for Ceylon.

Mr. De Mel said that he had tried it on high lands as a green manure with good results.

Mudaliyar Rajapakse thought that it was a plant which required good soil.

Mudaliyar Ramalingam said that the plant was grown in Jaffna and the fibre was made use of by fishermen.

The Chairman said that fibre was marketable and that brokers had made enquiries about it from time to time, but the difficulty was that not sufficient was grown to afford a commercial supply.

Agenda Item 4. Destruction of Prickly Pear.

The Chairman in introducing the subject for discussion said that Prickly Pear was a nuisance in several parts of the Island especially in Delft, part of the Northern Province and Trincomalie. A certain insect (*Dactylopius indicus*) was introducted long ago, and that insect was found to destroy one species of Prickly Pear, *viz. Opuntia monacantha* which is now rare in Ceylon. But there is another species, *Opuntia Dillenii*, which flourishes as a pest in the said districts, and Government Agents and others have repeatedly asked for some means of eradicating it. A few years ago, the Ceylon Department of Agriculture sent to Australia living examples of *Dactylopius indicus* which destroys *Opuntia monacantha*. The Australian Prickly Pear Board has now discovered another insect, *Dactylopius tomentosus*, which feeds on *Opuntia Dillenii*, and specimens of this species have been sent to Ceylon. It is expected that in course of time it will be possible to distribute this insect to those parts of the Island where Prickly Pear is a pest. It has found that this insect will not attack any other plant. But there was a doubt, which should be cleared up, whether the Prickly Pear is wanted by the people.

Messrs. Auchinleck, Drieberg and Mudaliyar Ramalingam offered remarks and in the course of which it was stated that Prickly Pear was a cattle fodder. The Chairman said that it was not the common Ceylon species which had been used as cattle fodder, any Prickly Pear was not cattle

fodder in an ordinary sense, but had to be mixed up with some other food. It was a "starvation" food, only used when there was a scarcity.

The Chairman said that a colony of insects was being reared at Peradeniya from which he hoped to make distributions to the different areas affected.

Agenda Item 5. Mudaliyar Edirisinhe's Motion.

The item 5 in the agenda was the following motion by Mudaliyar Edirisinhe, *viz.*: "That it is desirable in the interest of the Agriculturists that all available Crown land (for sale outright or for lease) should be carefully defined for each village, korale, or division and that lists of such available lands should be distributed among villagers and others likely to be interested in the development of such lands." As Mudaliyar Edirisinhe was prevented from attending the meeting, the discussion of the motion was postponed until the next meeting, as desired by him.

N. WICKRAMARATNE,
Secretary
Food Products Committee.

MATARA DISTRICT AGRICULTURAL COMMITTEE.

Proceedings of the first meeting of the District Agricultural Committee held at the Kachcheri on 26th Augut at 10 a.m.

ATTENDANCE.

Present.—Mr. G. S. Wodeman, Assistant Government Agent, in the Chair and the following members:—Messrs: F. Burnett, Divisional Agricultural Officer, A. T. Reeve, Plant Pest Inspector, C. B. Collison, J. E. Wijesinghe, E. J. Buultjens, R. C. Kanangara, G. Altendorff, D. Samaraweera, Mudaliyar W. A. Amerasekera, S. W. Ilangakoon, P. F. de Livera, H. E. Wickremeratne, W. A. Perera and W. A. Wijesinghe.

CONSTITUTION AND FUNCTIONS OF THE COMMITTEE.

1. Read letter from the Director of Agriculture intimating that His Excellency the Governor has approved the formation of the Matara District Agricultural Committee in place of the Food Production Committee. The Chairman explained that the present Committee has wider scope and functions than its predecessor and that it would be an advisory Committee to the Revenue Officer and the Divisional Agricultural Officer.

2. *Appointment of Secretary.*—Resolved that Mudaliyar W. A. Amerasekera be appointed Honorary Secretary.

3. *Quorum.*—Resolved that 7 members should form a quorum.

4. *Dates of Meetings.*—Resolved that quarterly meetings should be held and that the Monday of the 2nd week of the 2nd month of each quarter be allotted for the purpose.

5. *Notice of Meeting.*—Resolved that three weeks' notice of meetings be given.

6. *Notice of Motion.*—Resolved that at least 10 days' notice of a motion should be given to the Secretary who should circulate the agenda for the next meeting at least 5 days prior to such meeting.

7. *Emergency Meetings.*—In the event of any urgency a special meeting can be convened by the Chairman with 5 days' notice.

8. *General Scope of Committee.*—The Divisional Agricultural Officer next addressed the meeting and indicated the following points on which the Committee should concentrate its attention towards the furtherance of the objects for which the Committee is constituted.

(1) Local experiments, (2) Competitions, (3) Manuring trials, (4) Bunchy top, (5) Vel Vidane system, (6) Appointment of Committees to report on fences, markets, Co-operative Societies for citronella and coir yarns, (7) School gardens, (8) Home gardens, (9) Bee-keeping, (10) Circulation of Govikam Sangarawa and vernacular leaflets, (11) Green manuring, (12) Fencing, (13) Registration of schools, (14) Tanks, (15) Reafforestation, (16) Village irrigation, (17) Arecanuts—curing and sale, (18) Introduction of paddy lands, (19) Analysis of paddy soils, (20) Seed selection, (21) All pests and diseases, (22) Irrigation facilities, (23) Estates problems, (24) Conversion of the Goiya to new methods.

AGRICULTURAL EXPERIMENTS.

The Divisional Agricultural Officer next tabled the statistics prepared by him of the results of different manuring experiments with various manures tried throughout the District. The importance of the selection of seed paddy was indicated and several questions on this point were answered.

PLANT PESTS.

The Inspector of Plant Pests next detailed the operations carried on by him and his staff in the Four Gravets and Wellaboda Pattu, and stated that he was presently working in Weligam Korale and Ahangama in Talpe Pattu. The pests in Wellaboda Pattu and Four Gravets had almost been eradicated, though he thought that regular and frequent inspections were necessary effectively to rid the District of them. The pests referred to were the Coconut Caterpillar and Weevil.

WORKING OF THE CO-OPERATIVE CREDIT SOCIETIES.

The Assistant Registrar of Co-operative Credit Societies, Southern Province, next stated that there were 18 Societies in the District and that he considered that most of them were now on a sound footing, and quoted figures in support of his statement, as shown in the annexed schedule.

MR. WIJESINGHE'S MOTIONS.

The Chairman called upon Mr. Wijesinghe to speak on his motions in the order given in the agenda.

(1) Formation of Rural Agricultural Associations amongst the field owners and cultivators.

Mr. Wijesinghe briefly commented on his motion.

The Divisional Agricultural Officer thought that the proposal was not at all necessary in view of the fact that all agricultural matters can be discussed and effectively brought before Government through the numerous Co-operative Credit Societies in the District.

The motion was withdrawn.

(2) Eradication of Mimosa (sensitive plant) by bringing it under the Plant Pest Board.

Mr. Wijesinghe introduced his motion giving very briefly his reasons for bringing it forward. After discussion it was considered that Mimosa did not fall under the head of "Plant Pest". Mr. Wijesinghe withdrew his motion.

(3) The replacement of the primitive measure "Kuruni" by a measure of equal capacity.

After some discussion it was elicited that the object of the motion was to make the "Kuruni" a standard measure.

Resolved that this Committee is of opinion that the "Kuruni", being widely used as a measure of capacity of grain, should be standardised by law as the equivalent of one-eighth bushel in view of the local variations in the capacity of the measure.

(4) Removal of branches of shade trees by the roadside inclining towards paddy fields.

After Mr. Wijesinghe had given his reasons for the motion put forward, it was pointed out that under Irrigation rule No. 36 it was possible for land owners to have over-shadowing branches of shade trees lopped with the permission of the District Engineer. In case of refusal the Board would take up the matter and obtain the required permission.

The motion was withdrawn.

(5) Formation of threshing floors over flood level at convenient centres in tracts liable to be submerged.

The motion was withdrawn as the meeting was of opinion that it was impracticable to give effect to the suggestion.

(6) Restriction of the conversion of paddy lands to highlands without the permission of the Village Committee.

On it being pointed out that the motion was *ultra vires* the mover withdrew his motion.

REPRESENTATION ON THE BOARD OF AGRICULTURE.

Resolved that as the appointment of a representative of this Committee to the Board of Agriculture was not on the Agenda the member selected by the Food Production Committee should represent this Committee till a nomination is made at the next quarterly meeting.

CO-OPERATIVE SOCIETIES IN MATARA DISTRICT.

No.	Name of Society	Membership	Paid up capital. Rs. Cts.
1	Deniyaya	350	2,462.50
2	Morawaka	380	694.80
3	Urubokka	81	292.00
4	Mawarala	131	293.00
5	Akuressa	45	354.00
6	Telijjawila	87	621.00
7	Kamburugamuwa	100	867.00
8	Weligam Korale	421	5,000.00
9	Kandaboda Pattu	200	1,591.00
10	Gangaboda Pattu	410	3,316.00
11	Wellaboda Pattu	326	1,471.00
12	Matara	176	477.00
13	Yatiyana	185	1,786.00
14	Vitiyala	60	632.00
15	Ranchagoda	51	366.50
16	Walasgala	40	89.00
17	Madihe Sri Dhamawardena	86	889.00
18	Matara Wesleyan Mission	76	1,586.00

PROGRESS REPORT OF THE EXPERIMENT STATION, PERADENIYA.

For the Months of July and August, 1924.

TEA.

Crop shows an increase of 1,387 lb. of Green leaf over the previous two months. The eighteen-month old stumps grown from Kotiyagala seed which were planted in May are growing well. 1,020 vacancies were supplied in plots 163 and 164 with plants from Kanapediwatte Estate, Ulapane. The Dadaps in plots 144 and 149 were lopped in July yielding 7,482 lb. and 5,780 lb. of mulch per acre respectively. Half a maund of Dark Leaf Manipuri Indigenous tea seed received from Kanapediwatte Estate, Ulapane, has been planted in nursery beds for filling up existing vacancies. Selected seed received from Chapelton, Mousakande and Norwood estates have been put out in supply baskets to supply vacancies in the economic plots.

29 diseased tea bushes from 11 acres were uprooted and burnt. The highest losses occured in the Assam Indigenous plots.

RUBBER.

3,000 seeds from the Heneratgoda trees were sown in nurseries. Seed from selected trees of the offspring of the No. 2 Heneratgoda tree are being supplied.

The lower portion of the new Avenue rubber has been divided into blocks and interplanted with the following green manures :—Indigofera endecaphylla, Vigna oligosperma, Pueraria javanica, and Clitoria cajanifolia. The first three were propagated from cuttings about 15 in. long earthed up in the middle with the two ends sticking out. Indigofera endecaphylla is growing vigorously, Vigna oligosperma and Pueraria javanica have completely covered the ground. Clitoria cajanifolia seed has germinated well and the seedlings are making good growth.

The same green manures with the addition of Desmodium triflorum have been tried under old rubber in plot 87 with disappointing results.

One more tree which showed signs of root disease *Fomes lignosus* in plot 153 was uprooted and burnt and the affected area trenched. 47 trees were affected with abnormal leaf fall after the heavy rains.

CACAO.

The crop is extremely poor and the proportion of diseased pods is very large. 30 branches of each of the following types of cacao were layered by the gootee method for planting out in the Economic area:— Pentagona, Amelonado, Sambito and "Badulla pod."

COFFEE.

Dadap and Leucaena glauca shade over the coffee has been lopped and the branches mulched round the trees. All the trees in plot 140 G. 140 L and 140 K were given a surface dressing of cattle manure at the rate of one basket per tree. Holing the upper portion of the 6 acre coffee field has been completed and the holes are now being filled.

COCONUTS.

24 plants grown from nuts received from specially selected trees from Jugra Land and Carey Ltd, F. M. S., have been planted out in plot 161 at Bandaratenne along the river side.

2 San Remo plants grown from nuts kindly presented by Mr. F. J. M. De Mel have been planted out in plot 161. These nuts are said to be of excellent quality.

Couch and illuk have been uprooted in the Bandaratenne area.

FIBRES.

A very favourable report was received on the sample of Roselle fibre sent to the Imperial Institute, London. The merchants considered that consignments of similar quality should be readily saleable in London for use in admixture with Jute and possibly with certain of the lower grades of hemp. The fibre was valued by merchants in London at £ 27 per ton with "first marks" Calcutta Jute at £ 26 per ton.

Further plots of this fibre planted on the station are making satisfactory growth.

FODDER GRASSES.

The results of another year's trials, *viz*, August 5th, 1923. to July 31st, 1924, have been forwarded to members. The results have been summarised in the table under three headings (1) (Number of cuttings), (2) Yield, (3) Nutrient value.

GREEN MANURES AND COVER PLANTS.

Vigna oligosperma. Continues to make satisfactory growth under young rubber.

Clitoria cajanifolia. Seeds planted on a steep slope have germinated and the young plants are growing well. Various other green manure plants were tried on the same land without any success. Propagation by cuttings has so far not been a success, only 4% taking root. The plant has an erect habit, stands cutting and makes a dense cover in a short time.

Indigofera endecaphylla. The demand for seed and cuttings of this plant far exceeds the present supply. Orders for seed are being booked to be supplied next year and a limited number of cuttings has been supplied to applicants for trial and report.

Tephrosia candida. ¼ acre planted in poor soil was cut down for the first time yielding 2,108 lb. of green material.

Desmodium triflorum planted under old rubber has not proved a success in spite of planting in favourable weather. On the Show plots by the office it has completely covered the ground and formed a good turf.

Crotalaria usaramoensis (Crotalaria muijussi)—¼ acre was cut down yielding 3,611 lb. of mulch, including roots.

GENERAL.

The buildings on the station have received attention at the hands of the Public Works Department.

All available labour is at present employed in weeding and uprooting couch and illuk.

An outbreak of hoof and mouth disease has broken out amongst the cattle on the station. The animals affected have been segregated and treated and the road leading to the station closed. Two new pairs of estate bulls have been purchased for work on the station.

RAINFALL.

	Wet days	Inches.
July	23	11·79
August	18	10·87

H. A. DEUTROM,
Acting Manager, Experiment Station
Peradeniya.

AGRICULTURAL EDUCATION.

EDUCATION *VERSUS* RESEARCH.

The question has frequently been raised in the last few years whether the identity of the experiment stations is being maintained on a parity with that of previous years or with that of other branches of the colleges. It is realized that the stations are crippled in force and in the means for carrying on their work, that they have been overshadowed to some extent, and that they are not the prominent features in the agricultural colleges they once were. But how far has the effect of these things gone? Has it seriously affected their individuality, their autonomy, their existence as definite, organised agencies for providing the stock in trade of the other branches of college activities? It will be worth while to look into the matter in order to get a clearer view of present conditions, not to darken the picture but if need be to mend the situation.

The experiment station as organized under the Hatch Act is by law a department or branch of the agricultural college, designed to prosecute investigation and experimentation in agriculture. It is the organized research agency of the college, and is conducted under its direction, to supply the basis of teaching as well as to aid the business and practice of farming. As a part of the college, its destinies are largely in the care of the parent institution.

The Hatch Act sets forth certain objects and purposes and imposes certain duties and responsibilities on the station apart from those of the college as a teaching institution. These imply certain requirements, among them a force, funds, facilities, and administration to meet the desired ends. The station is so different, in its requirements and relationships, and its obligations are of such a character, that it may properly stand within the institution and before the public as a quite definite and distinct agency. This was evidently the original conception. It is related to the other branches of the college in various ways, and to some extent may share with them in equipment, facilities, and working force. But research is so spcialized and so different from the other lines of activity that in a large sense the station needs a force and facilities of its own, or which it can at least command for its use.

The experiment station is not designed as an aggregation of separate departments, each one working independently and to itself, but as an organized body of workers having many interests in common, needing policies to guide it and means of expressing itself and working out its destiny. It is not a body which any department may join at will, or participate in the privileges of without assuming obligations of service and of conformity to established requirements. It is an entity, and the Hatch Act had that in mind when it extended to it in the franking of its publications a privilege which was not applicable to other parts of the college.

Even in the early days when the stations were far smaller it was accepted that there was advantage in having this special branch properly organized and provision made for its administration. From the first this Office has advocated a strong, compact station organization, and experience the country over has afforded much proof of its desirability. The fact that it is within and a constituent part of a larger organization does not alter its organized character, or its need for special guidance and supervision. Rather is this need emphasized by affiliation of the members of its force with numerous subject matter departments in the college representing a variety of functions, which suggests the importance of means for securing the necessary degree of unity and cohesion in the station. Unification under a strong organization is further indicated by the character of problems it deals with, which are often wider in scope than single departments and call for a considerable measure of co-operation.

The purpose of the station is now viewed more broadly than it originally was, and the present view of the agricultural industry and what it implies gives a wider range to investigation helpful to it, all of which tends to increase rather than to minimize the importance of effective organization The larger the enterprise and the more numerous its contacts, the greater the need for a directing influence. The station must preserve its relations to the public and to education, and in carrying out its special function it must keep within the limits of its field and make it possible for other agencies to prosecute their special work effectively.

There seems little doubt, however, that the station organization has weakened in the past few years, and become a less definite unit of the institutions. This is borne out by the existing provision for it and the trend of developments as indicated by the following conditions.

The station directorship was from the first a position of recognized importance, A director was considered essential, and the manner in which that office has been conducted has been a very vital factor in determining the growth of the stations and their development as institutions for research. In recent years, however, the office has lost much of its distinctive character, and its duties have been merged with other duties to an extent which has left far less opportunity for serious attention to the station.

Ten years ago the station directorship at twenty-nine institutions was a separate office, the incumbent giving his primary attention to station affairs, while in twenty-one States it was combined with that of dean or (in two cases) president. At the present time the condition is practically reversed; the directors in twenty-eight stations have other duties, usually those of dean, and in nine cases those of director of extension, as well. Nine other station directors are also directors of extension.

It will be recognized, moreover, that while this change has been taking place the agricultural colleges have made large growth, both in size and in the complexity of their work, and agricultural extension has had almost its entire development. Hence, the demands on the deans and other combination officers have greatly increased over what they were ten years ago, when a separate administrative officer for the station was more common. At present considerably less than half the stations have an

administrative officer to themselves, while the remainder receive such attention as can be given from other engrossing duties. Although five stations have appointed an assistant or vice-director to whom more or less of the details of administration are assigned, it will be obvious that on the whole the provision for admininstration has quite materially declined, and the management has been merged with other duties which have grown greatly in scope and complexity. It has become in large measure incidental.

Such an enterprise as an experiment station calls for hard study to develop the basis of constructive growth and increasing efficiency. It is easy to get into a rut. There needs to be constant forward looking and critical self-examination. A round of routine is not necessarily progress.

Another factor in this connection is the attention given to special qualifications in filling the position of director. The directorship of practically half the stations has changed during the past six years, in five cases twice. Of these twenty-eight administrative changes it may be noted that in all but three cases the vacancies were filled by persons who had not had previous experience in directing a station; but what is more significant, half of them were likewise new to station work, only a small part having been previously engaged in investigation. This is a rather surprising change in the system for administering the stations. Obviously, it does not mark an advance in the provision for experienced leadership in the research field, and the inference is that in the selection the college was actuated by other reasons than those specially related to investigation.

The working force of an experiment station is the primary measure of its strength and its greatest resource in prosecuting its work. In the differentiation of function in the colleges, it might naturally be expected that since research calls for concentration and freedom from interruption, there would be an increasing segregation of a special station force with duties primarily connected with investigation, leaving to others the teaching and other branches of effort. This would seem natural also from the growth in other branches of the college which make larger demands on time, if not from consideration of the station welfare. But instead of this, the reverse has taken place. Here also the station has been spread out thinner, not only to cover its own field but that of the college.

As stated in a previous issue, the practice of requiring dual service from station employees has considerably increased, so that there are many less persons engaged exclusively in the service of the station to-day than there were ten years ago. In 1911 a little less than 43 per cent. of those on the station staffs had teaching or other duties in the college, while at the present time the proportion is fully 60 per cent. Beyond this, the relative amount of college work required of these dual-service employees has grown materially, owing to the pressure on the colleges and the difficulty of finding suitable instructors.

Moreover, the station staff is less definitely constituted at present than it was a decade ago. There is a growing tendency to list on the station staff practically everyone on the agricultural faculty who might carry on investigation. Indeed, several of the colleges make no attempt to constitute a station staff apart from the faculty as a whole; and often no very definite

distinction is maintained between the work of graduate students in degree courses and the systematic investigation carried forward under definitely constituted station projects.

Such mixed administration and the mixed or indefinite composition of the station staff tends inevitably to detract from the unity and individuality of the experiment station. There is little to bind the staff members together or familiarize them with its work as a whole. At many institutions they are rarely called together as a station body, but only as the faculty of the college of agriculture. This naturally goes a considerable way toward eliminating the station as an organization except in purely financial matters.

There is some confusion, also, between the graduate instruction and that of the station proper. Frequently such instruction is conducted by staff members wholly in the pay of the station, and the theses are published in the station series. Such work may promote research, even of the highest fundamental character, and on occasion it may have a very important relation to the station work in the advancement of knowledge; but, obviously, it ought not to be confused with the systematic work of the station. The latter is not designed as a graduate school, and a body of graduate students headed by the professors in charge does not constitute an experiment station. The tendency to blend these two agencies has the effect of further minimizing the station and detracting from its special character. This sometimes goes to the point where there is doubt on the part of department heads whether given pieces of work are station work or not, indicating that no real distinction is attempted. In such cases there is naturally little remaining of a station organization or recognition of such an agency in the State. The condition is in sharp contrast to that of extension.

It is perhaps natural that with a sharper definition of function in other lines, the field of the station should show a tendency to expand increasingly outside the domain of agricultural investigation. It has always provided for considerable regulatory work, and this has steadily grown in kind and amount to include, besides the regular inspections or analyses of feeds, fertilizers, seeds, nursery stock, etc., such things as stallion registration, advanced registry tests, egg-laying contests, forestry promotion and administration, certificates of ability in milk testing, and various other things.

In addition, other extraneous duties have been assigned to the station, such as the management of the college farm and other lands, and the carrying on of memorial farms or properties given to the college for such use as it might make. In several instances it is responsible for the only available facilities for instruction in animal husbandry, dairy farming, dairy manufactures, and the like. The head of one of the older stations said recently that the station administrative officers were no longer directors of research, since the stations had become so complicated and had had joined to them so many things only remotely related to their activity.

The effect of such a variety of duties is to confuse the public as to the real work and function of the station, and there are some evidences, moreover, that it serves to confuse local authorities. Not only does it deprive the station of its distinctive character, but it fails to discriminate between the research activities of the station and those of a general service bureau for the college and the State.

Moreover, it does not clarify the public view when a report designated as the annual report of the experiment station contains the record for the year of the whole college of agriculture, with much prominence to agricultural extension and other teaching and publicity activities. If such confusion exists, it is quite likely to extend to the particular needs of the station and finance at its disposal.

As a matter of fact, much difficulty has been experienced in securing more than a quite approximate statement of the funds available to the station, or those employed in connection with experiment and investigation. This is due to the failure of the college to segregate the station appropriations. For example, in several universities the State appropriation reported for the station comprises approximately the whole amount allotted to certain departments of the agricultural college, without respect to the amount devoted to the station activities. In other cases the station's share is a rough percentage approximation. Again, the State appropriations or allotments for the stations have carried the whole or part of the State fund for extension, and other appropriations made in the name of station have, under their provisions, been shared with the extension division. In other cases the appropriation, while charged up to the station, is so drawn as to be applicable to various other uses.

Such practice is a distinct disadvantage to the stations. It gives a quite wrong impression both within and without the institution of the support accorded investigation, and makes the station responsible for funds which contribute but sparingly to its welfare. Naturally it increases the difficulty in securing added financial support. As far as the institutions are concerned it may properly be taken as an indication or a result of an absence of clear identity.

How large this error may be and how far it may mislead both the public and the authorities themselves is indicated by the fact that the total revenue of the stations, amounting to more than $7,400,000 as reported by the institutions, shrinks on critical examination to something like $4,500,000 for investigation and experiment, including the Federal funds.

Many of the stations have no budget of their own and are not specifically mentioned in the budget of the institution. Allotments are frequently made to departments of the college out of the general appropriations, without designating the amounts assigned to the station work; and the funds which may be used for that purpose are such as can be found through economy in the general administration of the departments. The size of the assignments is often dependent on the needs of the institution in other lines, and fluctuates from year to year.

In numerous instances the needs of the station are not set forth in separate estimates but are combined with those of the larger organization, and in presenting these estimates to the legislature no special reference is made to the station. In such cases the public does not have the requirements of the station placed before it, and the station does not have its day in court. It is therefore cut off from a contact which is important to it, and its chance weakened of receiving the support it must have to grow. The extension work is not subjected to such a large element of chance.

A recent writer has charged the public with having abandoned interest in agricultural investigation—of almost total neglect, "even a reversal of the policy of the Nation as a whole and every State in it." He adds that "after having established the best (station) system in the world, the country has turned its back on its best piece of work." Leaving aside the question of whether the stations' cause has been adequately presented to the public, it is a fact that, even with the appropriations made by some of the stations last year, the total for 1920 stands at practically the same figure as for 1914, six years previous. Six States report decreases in appropriation during that period, aggregating nearly $178,000. Only twenty States show an increase in those six years amounting to as much as $10,000 or over. For twenty-eight States the increased State appropriation ranged from nothing up to $10,000, aggregating $87,000 for this group of considerably more than half the total number. This gives an average for those States of a little more than $3,000 in six years, or $500 a year in this period of unprecedented cost

But more money was appropriated to the colleges in that period than ever before. These same twenty-eight States increased their extension funds through direct State appropriation by a total of approximately a million and a half dollars, equivalent to an average of over $50,000 per State. When this average State appropriation for extension is compared with the average of $3,000 by the same States for the experiment stations, the neglect of the stations stands out in its naked reality. Perhaps the accounting system and the financial statement has misled both the public and the local authorities. If so, this may be due to less serious attention to its affairs.

Fortunately, the past winter has seen considerable effort in behalf of larger support for research. While it has resulted in gratifying increase in a number of States, the relief has by no means been general or such as to reinstate the stations in their former position.

It is manifest, therefore, that as a group the stations are not the prominent features in the colleges that they once were, and that they have lost much of their former unity and individuality. There are exceptions, of course, but in the main they have grown neither in resources, man power, nor prestige, while other branches have grown enormously. To an extent their condition represents a symptom, one which money alone will not remove.

Research has so long been one of the recognized functions of the colleges that it should need little argument for its support or the development of a progressive attitude toward it. It is necessary to all the other educational functions of the college: it is the ladder by which they have reached their present efficiency and popularity. It is proper, therefore, that it should be fostered in a manner not only of sympathetic understanding but of absolute concern—that it should take the form of a well defined, progressive policy for the experiment stations. The fate of the stations very largely depends upon it.

The dean of one of the large agricultural colleges has said in his last report: "It may fairly be maintained that the experiment station is the most vivid feature in the system of agricultural education. It is not merely a continuing source of new truth, but also an effective agency in keeping

alive in an institution the spirit of research—that attitude of mind which patiently examines the evidence before reaching a conclusion and is as essential to the honest presentation of truth as to its discovery." It is right to expect that a realization of this will be expressed in the attitude of the college—an attitude which is not only appreciative but aggressive in its behalf. It calls for more pronounced action than in the case of certain other branches which in a large measure now carry themselves. As has been said, because research does not have within itself the elements of publicity, it needs to be guarded by organisations and persons who understand its fundamental importance.

The changes of the past few years have brought the experiment stations into a different environment. Unaided they are not able to cope with the conditions of this new environment and make their way forward in competition with other branches of the institution. Even less successfully can they do so when they lack organization and when they have become so merged with other organizations and functions of the colleges that they no longer stand as the same definite, united branch of effort that they formerly did.

It does not necessarily require oversight or affirmative action to result adversely to the station. Inconsiderate action which does not take account of the possible effect on the station may be quite as serious. This is true also of diminished provision for attention to planning for the station, asserting its place in the institutional scheme of advancement, or protection of what it already has. Such reflex action is often one of the large factors in the situation, and it is not so much to be wondered at when the growth of the colleges has been so rapid and accompanied by such an expansion of interests and responsibility.

Interest in the smaller things has been on the wane. There is a tendency to stress things that are done on a large scale, which offer opportunity for rapid expansion, bring credit and popularity, and aid in helping to get funds for the whole institution. It is the appeal of larger opportunity for service, but unless guarded it is in danger of engulfing the most fundamental feature in a type of organization that is disadvantageous to it, in placing it in the hands of those with whom its interests are not primary, and of dissipating the efforts of its personnel, the life blood of research.

In what has been said there is no reflection upon the agricultural extensive service. The magnificent growth it has made and the success it has so rapidly achieved is a matter of common pride. It has become a forceful ally of the stations. It recognizes research as an essential foundation of its work, and it is giving intelligent and hearty support to the stations. It has built a strong organization, and its strength is in no small measure due to that organization. It has established an identity which has given it a recognized place, and defined its scope and function. It is just as important that the experiment station should have such an individuality and an organization suited to its special needs.

How far the present depressed condition of the experiment stations is the outgrowth of an attitude, a diminished identity, a merging of organization, it is not necessary to determine. But whether the condition is a symptom or a product, it is clear that the provisions made for the stations have not enabled them to assert themselves or served to check the drift of circumstances. A well-defined and aggressive policy has become one of the obvious requirements, not only for the progress of the stations themselves, but for the future welfare of the work of the college as a whole.—Editorial, Experiment Station Record, Vol. XLIV, No. 7.

CO-OPERATION.

CO-OPERATION IN JAPAN.

The 18th Congress of Co-operative Societies, held in April, 1922, passed a resolution declaring that the establishment of a central credit institution was absolutely necessary for the development of co-operative Societies in Japan, and decided that the Government should be asked to bring in a bill during the course of the next Session of Parliament for the establishment of such an institution.

On 10th February, 1923, the *Seiyu Kai*, the strongest of the political parties in Japan, introduced in the House of Representatives a bill to establish a central credit institute for co-operative Societies. This bill was passed, with certain amendments, by both Houses of Parliament and was promulgated as an Act in the Official Gazette of 6th April, 1923.

The main provisions of the Act are as follows :—

1. The Central Credit Institute for Co-operative Societies shall be established as an incorporated institution with headquarters at Tokyo.

2. Its funds shall amount to 30 million yen, to be constituted by the issue of 300,000 shares of 100 yen each. No person shall be entitled to hold shares, other than the Government and co-operative societies or unions of co-operative societies. The Government shall contribute a sum of 15 million yen, of which 5 million yen shall be paid within a year of the establishment of the Institute.

3. The main functions of the Institute will be to advance loans to unions of co-operative societies or to individual societies which are members of the Institute (no security being demanded, but repayment to be made by regular instalments), to discount bills, undertake exchange business, etc., for such societies, and to hold deposits of unions of co-operative societies, co-operative societies, public bodies or any other incorporated bodies established with aims other than that of making profits. The Central Credit Institute will also be entitled, under certain conditions, to issue bonds within the limit of an amount equivalent to ten times the amount of the contributions actually paid in.

4. The officials of the Central Credit Institute will be nominated by the competent Minister. In addition, a council of twenty persons will be set up, which will be consulted on important matters affecting the management of the Institute. The members of this council will be nominated by the competent Minister and more than half of them are to be persons connected with the co-operative movement. The management and the functioning of the Institute are placed under the supervision of the Ministers concerned. The Central Credit Institute is exempted, for a period of 15 years from the time of its establishment, from the payment of dividends on that portion of its shares contributed by the Government.

The number of co-operative societies is at present about 14,000, with a membership of about 3,500,000. The majority (12,000) of these are solely or partly credit societies. The sums held by these credit societies as deposits amount to about 250 million yen, and the amount of money advanced by them to 200 million yen. These figures indicate the urgent need for a central financial organization.

The actual institution of the Central Credit Institute is now being considered, and it is expected that it will come into existence during the present month.

The Establishment of National Union of Purchase Societies.

The Central Union of Co-operative Societies has finally succeeded in its efforts to establish a national union of purchased societies, the inaugural meeting of a national union being held at Tokyo on 19th April.

The principal office of the Union will be at Tokyo and branch offices will be established at Osaka and other places. Membership will be open to co-operative purchasing societies or unions of such societies. The union will purchase or produce for the member societies the goods required by them.

At present, there are about ten thousand co-operative societies which are solely or partly purchase societies and over a hundred unions of such societies. It is obviously not to the interest of these societies to be obliged to purchase the goods required by their members from the ordinary merchants or manufacturers, as has been done up to the present. The need for the establishment of a national union of these purchase societies which will undertake the manufacture or the wholesale purchase of such goods has been increasingly felt.

The creation of the Central Credit Institute and the establishment of the National Union of Purchase Societies is regarded as opening up a new phase in the activities of co-operative societies.

DEVELOPMENT OF CONSUMERS' CO-OPERATIVE SOCIETIES.

As already stated there are a considerable number of co-operative societies and societies which are solely or partly purchase societies, but these purchase societies mainly deal with the purchas and sale of agricultural implements and materials for the agricultural population. Thus according to investigations made by the Department of Agriculture and Commerce, at the end of the year 1921 there were only 90 co-operative societies, with a membership of 42,668, which could be strictly regarded as ordinary consumers' co-operative societies, and the more developed examples of these societies were only to be found in large cities such as Tokyo and Osaka. Investigations made by the same Department also show that in the year 1920 there were, in and near the city of Tokyo, 33 consumers' co-operative societies with 26,881 membe and contributions to the mount of 476,332 yen paid up, and in and near the city of Osaka 18 societies with a membership of 13,000 and 182,000 yen paid up.

Since the time of these investigations, however, a certain development has been noticed in the consumers' co-operative movement, both at Tokyo and at Osaka. At Tokyo, by the end of the year 1922, a scheme had been carried out to establish a Union of Consumers' Co-operative Societies i

the Tokyo prefecture. Thirty-six societies with 31,200 members were affiliated to this Union at its start. In Osaka, by the end of September, 1922, there were 17 consumers' co-operative societies—10 in the city and 7 in the neighbourhood—and of these 17 societies, 4 were maintained chiefly by the working classes. On 11th February, 1923, a new consumers' purchase society for the working classes was established in Osaka, with a membership of 12,000.

It has long been regretted that the development of urban consumers' co-operative societies in Japan has made so little progress and the Department of Agriculture and Commerce recently called a meeting of the representatives of consumers' co-operative Societies of various cities to enquire into the causes which hindered their development. The main causes were considered to be: (*a*) insufficient funds; (*b*) lack of support from the members of co-operative societies, who often bought from ordinary retailers articles which they could obtain from their co-operatives; (*c*) absence of a fixed subscription. Members are asked to contribute according to what they can afford and accordingly those who have contributed a large sum are liable to obtain a greater influence in the management of the society and to misuse the society for their own private interest.

It is reported that since this meeting the Department of Agriculture and Commerce has decided to set up a commission to investigate the causes of the inactivity of the co-operative societies, and to consider measures to be taken to encourage the movement. The commission will be composed of representatives of co-operative societies, representatives of the Government departments concerned, and well-known business men.

CONGRESS OF CO-OPERATIVE SOCIETIES.

This year's congress of co-operative societies was held on 25th and 26th April in the city of Sendai under the chairmanship of Mr. Shimura, the President of the Central Union of Co-operative Societies. A resolution was passed declaring it to be "lamentable that at such a critical time, when the economic competition between nations is becoming keener as it has been doing since the great war, the productive efficiency of the Japanese Empire should be decreasing year by year." The co-operative societies, the resolution stated, should take up the difficult task of restoring the economic activity of the Empire.—The Mysore Economic Journal, Vol. X. No. 7.

POULTRY-FARMERS AND CO-OPERATION.

JAMES HADLINGTON.

It is encouraging to note the efforts put forward by branches of the Agricultural Bureau and poultry societies for co-operation in purchasing poultry food and supplies. Miranda, Carlingford, Wentworthville, Blacktown, and recently Eastwood are notable instances of the benefit to poultry-farmers arising out of such organisation. This is one way by which a reduction in cost to the consumer and greater profit to the producer can be brought about. By making wheat available direct to poultry farmers in 1918 the Department showed the way to collective purchase of poultry foods. The Department is doing much to encourage this class of organisation among poultry-farmers.—The Agricultural Gazette of N. S. W., Vol XXXIV, Part 3.

GENERAL.

THE EFFECT OF SUNLIGHT ON THE GERMINATION OF PAPAYA SEEDS, *CARICA PAPAYA*.

EMILIO K. MORADA.

Assistant in Horticulture.

It is a well-known fact that sunlight plays an important rôle in the germination of seeds. How much sunlight is required to give a satisfactory result for an individual variety of seeds is the chief aim of this experiment. The absence of sunlight will either hinder or destroy more or less the germinative power of the seed, because it deprives the seed of the stimulant which hastens its germination. The quantity of light necessary for the germination of seeds depends on the intensity of the sunlight the size and the characteristics of the covering of the seeds in question. The smaller the seeds the less light is needed. The harder and the thicker the covering is, the more light is required.

To germinate the papaya seeds successfully a proper amount of light is required. Many people fail to germinate papaya seeds because they do not provide the necessary amount of light required for the best germination. They often place them either under total shade or sunlight and as a result the seeds will give a low germination or none at all. In the first case, the seeds will be dormant for a long time; while in the second case the germinating power is lost due to the excessive amount of sunlight. Therefore, in order to avoid the many failures in germinating papaya seeds, this experiment on the relation of sunlight on its germination was conducted at the Lamao Experiment Station, Lamao, Bataan.

PLAN OF THE EXPERIMENT.

A good sized ripe fruit of Hawaiian papaya was obtained. The seeds were taken and washed thoroughly by removing the outer covering and the watery substance adhering to the seeds. Then they were dried at room temperature for a day. The seeds were then divided equally into five portions of 300 seeds each. The seeds in each portion were planted in separate earthen pots of about 22·5 cms. in diameter, filled with soil, leaving only about 3 cms. unfilled. The seeds were broadcasted on the surface and covered with a thin layer of soil. Each pot was subjected to the following conditions:

1. Entire shade,—the whole day without receiving heat of the sun.
2. Entire shade,—the pot was placed in the shade near the edge of the building the whole day so that it received more light than No. 1.
3. Half day sunshine from 7 a.m. to 11-30 a.m.
4. Partial shade,—under the nursery shed.
5. Entirely exposed in the sunlight the whole day.

The pots under all the conditions received the same treatment as to watering, mixture of soils, drainage, etc.

The dates and per cent. of germination were recorded.

After a month the pots under the first and second conditions were placed under the third condition to determine whether the seeds which did not germinate would still grow.

A second set of similar experiment has been undertaken to verify the first results.

Tables I and II indicate the results of the experiment.

TABLE I.

Conditions	Date		Number of seeds germinated	Percentage of germination	Remarks
	Planted	Germinated			
1.	April 5		0	0	Subjected to condition 3 on May 17. Fifteen seeds germinated on May 23, -5 per cent.
2.	April 5	April 19	44	14·66	
3.	April 5	April 15	107	35·66	
4.	April 5	April 15	63	21·0	
5.	April 5	—	0	0	

TABLE II.

Conditions	Date		Number of seeds germinated	Percentage of germination	Remarks.
	Planted	Germinated			
1.	May 17	June 28	3	1·00	Subjected to condition 3 on July 2. Twenty-five seeds germinated on July 10, —8·33 per cent.
2.	May 17	June 28	8	2·66	Subjected to condition 3 on July 2. Thirty-two seeds germinated on July 8,—10·66 per cent.
3.	May 17	May 28	80	26·66	
4.	May 17	May 28	41	13·66	
5.	May 17	—	0	0	

DISCUSSION OF RESULT.

It will be noticed in Table I that the seeds germinated under conditions 2, 3, and 4, while the seeds did not germinate under conditions 1 and 5. Under condition 3 the highest percentage of germination was obtained, which is 35·66 per cent.; under condition 4, is 31·0 per cent.; and under condition 2, 14·66 per cent. The seeds under condition 5 did not germinate because of the excessive sunlight which destroyed the vitality of the seeds. No germination was obtained under condition No. 1 but in subjecting the seeds to condition 3, 5 per cent. germination was obtained. This shows that the seeds are dormant in a shady place, and no germination could be obtained unless a certain amount of sunlight was given them. It takes also longer time for the seeds under condition 2 to germinate than those under conditions 3 and 4.

In the Experiment shown in Table II, the same results have been obtained, comparatively speaking. Under condition 3, 26·66 per cent.

germination was obtained, the highest percentage of germination ; under condition 4, 13·66 per cent.; under condition 2, 2·66 per cent.; and under condition 1, 1·0 per cent. The seeds under condition 5 did not germinate. In subjecting those under conditions 1 and 2 to condition 3 they gave a germination of 8·33 per cent. and 10·66 per cent. respectively. The seeds under conditions 3 and 4 germinated in 11 days while those under conditions 1 and 2 previous to other treatments germinated in 42 days. On putting under condition 3, the seeds under condition 2 germinated in 6 days while those under condition 1 germinated in 8 days. In all cases, there was a low percentage of germination.

From the above results, it is therefore self-evident that a certain amount of sunlight is necessary in the germination of papaya seeds and that its absence retards the germination of the seeds, and may destroy the germinative power of same also. Too much sunlight as under condition 5 destroys the vitality of the seeds while too little sunlight retards the germination. One-half day sunshine from 7 a. m. to 11-30 a. m. and one-half sunshine under partial shade is the amount of sunlight necessary for the germination of papaya seeds.

CONCLUSION.

1. Seeds under total shade during the whole day will not germinate but on exposing to sunlight for one-half day, they will.

2. One-half day sunshine from 7 a. m. to 11-30 a. m. and partial shade (under nursery shed) are the best conditions under which seed germinate.

3. Too much sunlight is detrimental to the seeds. It destroys the vitality of the seeds. On the other hand, the absence of sunlight will retard the germination. The seeds will be in a dormant stage.—The Philippine Agricultural Review, Vol. XVII., No. 1

THE SCHNEIDER CHALLENGE CUP FOR SCHOOL GARDENS.

REPORT FOR 1923—24.

The Cup, which is open for competition by registered school gardens attached to Government and Grant-in-aid schools in the Chilaw and Puttalam districts, was competed for by seven schools :

1. Etiwala Govt. B. V. S.
2. Wekada do
3. Nathandiya Govt. A. V. B. S.
4. Kelegame Govt. V. M. S.
5. Walahapitiya do
6. Walpaluwa do
7. Medagama do

The schools were visited twice during the period October, 1923, to July, 1924, for purposes of judging, though some schools, which were considered as requiring particular help and advice, were given the benefit of several visits.

2. In judging, marks were allotted for general arrangement of the garden, cleanness, ornamental work (including hedges, etc.), fruit and vegetable sections (showing varieties grown, methods, etc.), manuring practised, tilth of the soil and evidence of marked originality.

No consideration was given to Wekade B. V. S. as hardly any work was done, and the low standard reached by Etiwela B. V. S. is due to the smallness of the garden and the cabooky nature of the soil. Medagama B. V. S. was at a great disadvantage by the extra work necessitated for

bringing the new area under cultivation for the competition. The winner of the Cup, *viz.* Kelegama V. M. S. which is situated in a dry and neglected part of the district has done remarkably well in obtaining 70 points out of a maximum of 100, and the children have put in real hard work. At the final judging the garden had no less than 54 varieties of vegetables and yams ; the beds had been well weeded, and the garden on the whole was neat and clean.

The other three schools in order of merit had reached a high standard, which made judging a matter of some difficulty. Nathandiya B. V. S. in particular had put in hard work, and its ornamental section was the best among competing schools. The fruit section was on the whole disappointing, and there is much room for improvement in this branch.

SCHOOL GARDEN COMPETITION, NORTH-WESTERN PROVINCE.

The results of the above Competition, which was inaugurated in 1921 for prizes offered by the Hon'ble. Lt.-Col. T. Y. Wright are now available for 1924. The judging was done by a member of the Department of Agriculture who visited each competing school between October, 1923 and July 1924. The competition was open to schools in the North-Western Province. Twenty-six school gardens in Kurunegala district and six in the Puttalam-Chilaw districts entered the competition, and the results are as follows :—

KURUNEGALA DISTRICT.

1st price Rs. 50/-	Nakkawatte Boys' School Garden	499 marks
2nd ,, ,, 25/-	Ehetuwewa Do do	430 ,,

CHILAW-PUTTALAM DISTRICTS.

1st prize Rs. 25/-	Maiyawa Mixed School Garden	76% marks.

As a result of this competition considerable improvement in the school gardens of the North-Western Province has been effected, and the cultivation of vegetables and curry stuffs such as cummin, garlic, etc., is becoming more popular.

EFFECT OF WEIGHT OF SEED UPON THE RESULTING CROP

W. E. BRENCHLEY.

Experiments with barley and peas, in which the competitive factors were eliminated as far as possible, showed that a steady and considerable rise occurs in the dry weight of the plants as the initial weight of the seed increases. This takes place with both limited and abundant food supply. The efficiency index (rate percentage of increase per day) falls gradually as the weight of the seed rises. With prolonged periods of growth this tends ultimately to counterbalance the initial advantage gained by plants from the heavier seeds, but, with such annual crops as cereals, roots, and peas, harvesting occurs before this equilibrium is reached, leaving the advantage with the heavier seeds. The relative development of shoot and root is influenced to some extent by the initial weight of the seed but may vary with the species and with the amount of available food. The results are thought to lend support to the practice of advocating the use of large heavy seed, especially with annual crops.—Experiment Station Record, Vol. V, No. 7.

MARKET RATES.

MARKET RATES FOR SOME CEYLON PRODUCTS.

(FROM THE CEYLON CHAMBER OF COMMERCE WEEKLY PRICE CURRENT, DATED 15th SEPTEMBER, 1924.)

NAME OF PRODUCE		CURRENT PRICE			REMARKS
		Rs. cts.	at	Rs. cts.	
CACAO—(At Buyer's Stores)					
Estate—Finest	... per cwt.	... ...	,,	... ...	
Do Medium	... do	... ...	,,	... ...	
Do Common (Black)	... do	10 00	,,	15 00	
CARDAMOMS					
All round parcel well bleached ...	... per lb.	... ...	,,	... ...	
Do do medium ...	... do	... ...	,,	... ...	
Special assortment 0 & 1 only ...	... do	... ...	,,	... ...	
Seeds	... do	... ...	,,	... ...	
Green	... do	2 80	,,	3 12	
CINNAMON QUILLS—(At Buyer's Stores)					
Ordinary assortment (in bales of 100 lb. nett) ...	... per lb.	0 74	,,	0 82	
No. 1	... do	0 77	,,	0 85	
No. 2	... do	0 75	,,	0 83	
No. 3	... do	0 72	,,	0 80	
No. 4	... do	0 68	,,	0 76	
CINNAMON CHIPS—Maradana, (At Buyer's Stores) (in bags of 56 lb. nett) per candy of 560 lb.		70 00	,,	75 00	
CITRONELLA OIL—(ex-Seller's Stores without packages) ...	per lb.	1 80	,,	1 90	
COCONUT—(Desiccated) Granulated goods (Delivered at Wharf or Buyer's Stores)					
Assortment: Medium 50 per cent. Fine 50 per cent. ...	per lb.	0 20½	,,	0 22½	
COCONUT OIL—					
White Oil f.o.b	per ton	590 00	,,	605 00	
Ordinary Oil do	do	560 00	,,	562 50	
COPRA—					
Calpentyn	No. 1 quality per candy of 560 lb.	80 00	,,	86 50	
Estate	,, ,,				
Ordinary quality (Maravila)	,, ,,				
Cart Do do	,,				
FIBRES—(At Buyer's Stores)					
Coconut Bristle No. 1	... per cwt.	8 50	,,	10 00	
Do No. 2	.. do				
Coconut Mattress No. 1	... do	2 90	,,	3 25	
Do No. 2	... do				
Coir yarn, Kogalla Nos. 4 to 9 ...	... do	12 00	,,	25 00	
Do Colombo Nos. 3 to 7 ..	... do	12 00	,,	25 00	

PLUMBAGO		X. B.			B			B. E.		
		Rs. cts.		Rs. cts.	Rs. cts.		Rs. cts.	Rs. cts.		Rs. cts.
Ordinary Lumps ...	... per ton	250 00	at	300 00	... ...	at	250 00	175 00	at	180 00
Chips ...	... do	160 00	,,	250 00	190 00	,,	200 00	100 00	,,	125 00
Dust ...	... do	140 00	,,	175 00	100 00	,,	125 00	50 00	,,	75 00
Do Flying ...	... do	100 00	,,	145 00	... ...		95 00	30 00	,,	60 00

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 30th SEPTEMBER, 1924.

Province, &c.	Disease	No. of Cases up to date since Jan 1st, 1924	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	1128	193	411	653	48	16
	Foot-and-mouth disease	1858	288	1790	17	51	—
	Anthrax	7	—	—	7	—	—
	Hæmorrhagic Septicæmia	6	—	2	4	—	—
	Rabies	1	1	—	—	—	1
Colombo Municipality	Rinderpest	1071	357	*			
	Foot-and mouth disease	151	31				
	Anthrax	—	—				
	Rabies	2	—	—	2	—	—
Cattle Quarantine Station	Rinderpest	10	—	*			
	Foot-and-mouth disease	27	—				
	Anthrax	161†	20				
	Pleuro-Pneumonia (in goats)	115	22	—			
Central	Rabies (Dogs)	13	1	—	13	—	—
	Foot-and-mouth disease	808‡	86	711	14	77	—
	Anthrax	8	—	—	8	—	—
	Hæmorrha gicSepticæmia	1	—	—	1	—	—
	Piroplasmosis	4	—	4	—	—	—
	Mange (in Buffalos)	6	—	6	—	—	—
Southern	Rinderpest	130	46	35	96	9	—
	Foot-and-mouth disease	2	—	2	—	—	—
	Anthrax	—	—	—	—	—	—
Northern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	—	—	—	—	—	—
	Anthrax	—	—	—	—	—	—
	Hæmorrhagic Septicæmia	98§	—	3	95	—	—
Eastern	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	9	—	9	—	—	—
	Anthrax	—	—	—	—	—	—
North-Western	Rinderpest	318	39	113	185	7	13
	Foot-and-mouth disease	1266	88	1235	5	24	2
	Anthrax	12*	—	—	12	—	—
	Rabies (Dogs)	2	1	—	—	—	2
	*1 dog						
North-Central	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	130	21	130	—	—	—
	Anthrax	—	—	—	—	—	—
Uva	Rinderpest	—	—	—	—	—	—
	Foot-and-mouth disease	—	—	—	—	—	—
	Anthrax	3	—	—	3	—	—
	Black Quarter	26	—		26	—	—
Sabaragamuwa	Rinderpest	32	25	2	23	1	6
	Foot-and-mouth disease	1949	435	1670	5	274	—
	Anthrax	12	—	—	12	—	—
	Hæmorrhagic Septicæmia	17	—	—	17	—	—
	Rabies (Dogs)	2	—	—	1	—	1

* Up to end of August.
† 2 cases amongst cattle, the rest amongst goats.
‡ 39 cases mouth disease in goats.
§ 23 cases amongst goats.

M. CRAWFORD,
Acting Government Veterinary Surgeon.

Colombo, 6th October, 1924.

METEOROLOGICAL
SEPTEMBER, 1924.

Station	Temperature: Mean Daily Shade	Temperature: Difference from Average	Mean Humidity	Mean amount of Cloud 0=clear 10=overcast	Mean Wind Direction during Month	Daily Mean Velocity	Rainfall: Amount	Rainfall: No. of Rainy Days	Rainfall: Difference from Average
	°	°	%			Miles	Inches		Inches
Colombo Observatory	80·8	—0·2	83	8·8	SW	144	15·01	21	+ 9·72
Puttalam	81·9	+0·1	78	4·1	SW	247	3·14	12	+ 2·15
Mannar	83·9	+0·6	75	7·6	SW	226	3·47	7	+ 2·41
Jaffna	82·6	+0·1	78	7·2	SW	317	5·65	8	+ 2·77
Trincomalee	83·5	—1·1	72	6·4	SW	216	5·93	9	+ 1·46
Batticaloa	82·7	—0·9	74	5·2	E	124	5·06	8	+ 2·41
Hambantota	80·0	—1·1	82	5·2	WSW	347	6·58	16	+ 4·25
Galle	79·7	—0·3	85	6·8	W	261	17·64	24	+ 9·63
Ratnapura	79·7	—0·3	84	7·8	—	—	25·97	26	+ 11·01
Anu'pura	82·6	—0·8	72	6·7	—	—	10·47	13	+ 7·64
Kurunegala	80·0	—0·9	82	8·0	—	—	12·05	19	+ 7·04
Kandy	74·2	—1·6	84	8·2	—	—	12·64	26	+ 6·71
Badulla	74·6	—0·5	80	6·4	—	—	11·39	19	+ 8·02
Diyatalawa	69·2	—0·3	74	7·6	—	—	13·04	20	+ 9·45
Hakgala	62·1	+0·5	85	8·0	—	—	9·81	26	+ 3·70
N.' Eliya	60·8	+1·4	87	8·7	—	—	15·88	29	+ 7·59

The rainfall during the month was above normal practically everywhere, but especially in the south-west of the island. The excess was greatest in the low-country districts lying between Colombo and the hills. Carney with a rainfall of 51·98 inches, and Maliboda, with 48·57, were over 26 inches in excess. Watawala, with 51·21, was over 23 inches in excess, Digalla and Labugama, with 38·95 and 35·53 respectively, were over 22 inches in excess, and Keragala, with 37·88, was over 20 inches in excess.

67 daily rainfall totals of over 5 inches have, up to the present, been reported for September. Of these, seven, all on the 29th-30th were over 10 inches. These are, Maliboda, 12·00; Carney, 11·98; Kitulgala, 11·22; Kenilworth 10·74; Padupola, 10·22; and Blackwater and Ingoya, 10·10 inches each. Sunderland estate reported falls of over 5 inches on four separate days during the month.

Floods were reported at many places, both after the heavy rains of the 18th to 25th, and after the deluge of the 29th-30th. To the latter was due the heavy floods experienced in Colombo, which reached their maximum the following week-end.

The temperature for the month was slightly in deficit, except in the north east of the island and at Nuwara Eliya, where it was slightly in excess. The direction of the wind was generally South West, and its strength slightly above normal. The humidity was between 70 o/o and 80 o/o in the lee of the hills, and over 80 o/o on the windward side of the island. Cloudiness was nearly everywhere in excess, and barometric pressure, on the whole about normal.

H. JAMESON,
Acting Supdt., Observatory.